Official, No. 9.

QUARTERLY WEATHER REPORT

OF THE

METEOROLOGICAL OFFICE

For 1870.

METEOROLOGICAL OFFICE
C

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1872.

Stack 6

PREFACE.

PART I. of this Volume appeared in July 1871, and Part II. in October. Part III. was not published until February, owing to the delay caused by the adoption of a new process for the publication of the curves.

The method followed in Parts I. and II. was the same as that employed in the last part of the Report for 1869, viz.: that dry impressions from copper-plates have been transferred to stone, so that the printing has been lithographic.

With Part III. the Office has commenced to print directly from the copper plates, and this practice will be continued in the succeeding numbers.

The process of printing *dry* from the copper being very slow, and consequently costly, the printing of Part IV. has been executed by the wet process, the paper having, however, been damped as little as possible. As, however, shrinkage has been unavoidable, any measurements on these plates must be effected by means of their own side scales.

The scale portion of the Plates is obtained by the process of electrotyping.

The successive steps of the reproduction of these automatic records in the form of these Plates have been described at full length in the Annual Report of the Office for the year 1870.

It will be observed that in the last two Parts the small Charts illustrative of the weather when any special features of interest are observable have been introduced in the Plates instead of in the text of the Report.

May 1872.

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ERRATA.

Page 19, line 11 from bottom, for “11 a.m.” read “11 p.m.”
„ 22, last line but one, for “to” read “and.”
„ 23, Valencia, minimum barometer for January, for 28·516 read 28·541.
„ range „ „ „ 2·053 „ 2·028.
„ 34, 3rd line of table, Alnwick Castle, maximum velocity, for 10 p.m. 18th, read 10 p.m. 17th.
„ „ last „ „ „ „ „ 10 p.m. 20th „ 10 p.m. 19th.
„ 36, Kew, barometer range for May - - - - for 1·107 read 1·053
„ 37, Valencia, temperature range for May - - - - „ 23°·9 „ 24°·9
„ 41, Line 20 - - - - - - - - for 1.30 a.m. read 1.30 p.m.
„ 59, Table. Remarks. Aberdeen - - - - - for 5 a.m. read 5 p.m.
„ „ „ „ Falmouth - for S.W. by S. at 8 a.m. read S.W. by S. at 8 p.m.
„ 61, Mean velocity, Aberdeen - - - - - - for 17th read 16th.

APPENDIX.

			D.	H.			D.	H.	
Page [1].	Valencia, minimum barometer for June -	for	1	0	29·852	read	17	6	29·828
„ [2].	Aberdeen „ thermometer „ -	„	9	16	42°·1	„	11	13	41°·3
„ [3].	Stonyhurst „ „ for July -	„	12	15	48°·1	„	28	17	46°·5
	„ „ barometer „ August -	„	4	16	29·264	„	27	19	28·901
„ [4].	Kew, maximum thermometer „ February -	„	28	1	53°·2	„	28	0	53°·6
	„ „ „ „ May -	„	19	3	75°·6	„	21	5	81°·0
	„ minimum „ „ „ -	„	3	17	32°·4	„	8	17	32°·0
	„ maximum „ „ June -	„	19	5	79°·6	„	16	4	86°·3
	„ minimum „ „ „ -	„	5	16	44°·5	„	6	16	43°·4
	„ maximum „ „ July -	„	25	2	85°·0	„	22	3	85°·4
	„ „ barometer „ September	„	15	22	30·518	„	30	20	30·544
„ [5].	Glasgow, barometer, Jan. 6–10 - - - -	for			30·222	read			29·222
	Stonyhurst, wet thermometer, May 11-15 - - -	„			56°·9	„			46°·9
„ [6].	Kew, barometer, Oct. 23–27 - - - -	„			30·388	„			29·388
	„ „ Dec. 7–11 - - - -	„			30·753	„			29·753
	„ „ „ 12–16 - - - -	„			30·522	„			29·522
	„ „ „ 17–21 - - - -	„			30·856	„			29·856
	„ „ „ 22–26 - - - -	„			30·841	„			29·841
„ [8].	Average for 1866, Nairn - - - -	„			29·735	„			29·725
	„ „ Yarmouth - - - -	„			29·883	„			29·874
„ [18].	Nairn, rainfall, April - - - - -	„			1·68	„			1·66
	„ equivalent per-centage, November - - -	„			5·4	„			5·8
„ [19].	Valencia rainfall, February - - - -	„			4·50	„			4·51
	„ „ March - - - - -	„			4·04	„			4·05
„ [20].	Sept. 12, Aberdeen, per-centage of monthly mean - -	„			59·5	„			53·7
„ [21].	July 9, Plymouth, per-centage of annual mean - -	„			2·11	„			2·88
	October 22, Valencia, per-centage of monthly mean - -	„			27·2	„			17·2

EXPLANATION OF TECHNICAL TERMS USED.

“Gradient.”—The amount of difference in barometrical readings over a given distance, calculated in hundredths of an inch of mercury per fifty geographical miles.

“Anemogram”
“Barogram”
“Thermogram” } The continuous record, for wind, pressure, or temperature respectively, furnished by a self-registering instrument.

“Isobaric Lines”
“Isobars” } Lines joining the stations where the pressure is equal on any day.

“Veering and backing of wind.”—The wind “veers” when it shifts *with the sun* from E. through S. to W. or through any azimuth in that direction. It “backs” when it shifts *against the sun* from W. through S. to E. or through any azimuth in that direction.

“Cyclonic.”—The wind is said to have cyclonic motion when it sweeps through any arc round an area of relatively low barometrical pressure. In this case the horizontal motion of the air is always against the sun.

“Anti-cyclonic.”—The wind is said to have anti-cyclonic motion when it sweeps through any arc round an area of relatively high barometrical pressure. In this case the horizontal motion of the air is always with the sun.

INTRODUCTION.

THE most important points calling for notice in the present volume, as compared with its predecessor, are the modifications which have been introduced into the graphical representations of the curves. The entire record for five days is given on one plate instead of two, as heretofore.

The scale for the barograms and thermograms has been reduced to four-fifths of its former size. The chief reason of this alteration has been to extend the scale, and so obviate the necessity of constant change of the *datum*. The present scale allows a range of 2·5 ins. for the former and 50° for the latter, instead of 2 ins. and 40° respectively. An inch of the barometer scale is now represented by 0·6 in. on the printed plate, and 10° Fahr. by 0·3 in. The scales of both these instruments extend over the entire space allotted to each observatory.

In order to render it possible to give the wind and rain on the same plate as the other elements two important changes have been made.

The velocity traces, as now given, represent for each hour independently the record of the anemograph during that hour, so that a shaded area is produced whose outline approximates to the curve of mean hourly velocity. This improvement has been suggested by Mr. De La Rue.

The velocities are measured by the side scale, which is compressed so that 100 miles correspond to 2 inches of the barograph scale. It may be reasonably supposed that a higher velocity than 100 miles an hour will scarcely ever be registered.

As horizontal lines are drawn across the plate at each half inch of the barograph scale, or at each 25 miles of the anemograph scale, it is obvious that if the velocity trace dips below the first of these lines, the wind must be blowing with the force of a stiff breeze, while if it passes below the second, corresponding to 50 miles an hour, there must be a strong gale.

The direction trace has been reduced very considerably, as it was found that sufficient distinctness could be secured for it if reduced to one fifth of the scale used in Vol. I. By this means it will exactly fit into the space corresponding to half an inch of the barogram scale.

For the sake of clearness the points between E. and W., round by S., have been shaded, so that as long as the trace remains in the shaded portion, the direction of the wind must be from the southward of East or West respectively.

The Barograms and Thermograms will thus range over the entire space allotted to the observatory; the Velocity of the wind will be given in the upper division of this space, and its Direction in the lower.

It has been determined to increase the amount of information represented graphically, by giving the continuous curve of inches of Vapour Tension. The scale for this corresponds with that of the barogram, and is given at the side, its zero being the upper line of the space devoted to the Wind Direction.

The record of vapour tension has been obtained by calculation of its hourly values by means of Kupffer's tables.* The office has, however, again to express its acknowledgments to Mr. Francis Galton, who has invented an instrument of general application, wherever a function of two variables is concerned, which renders it possible to protract the trace of vapour tension directly from the dry and wet bulb thermograms. The instrument is now complete, and will be described in due course in the Annual Report of the Committee which is furnished to Parliament, in the successive numbers of which publication all particulars relating to the instruments are to be found.

It is the intention of the Committee to give the continuous records from the self-registering rain gauges as soon as they are available, and to reproduce them on le/ a similar princip~~al~~ to the traces of wind velocity. For the present, the rain gauges at all the stations, except Aberdeen and Falmouth, are measured at 10 a.m. daily. The amount collected is entered on the vertical line corresponding to 9 a.m. on the plate. The quantity of course refers to the preceding 24 hours.

Lastly, in order to avoid unnecessary complication of the curves, the respective *data* for the different elements are chosen so as to keep the traces as clear of each other as is possible.

In order to admit of the additional side scales the millimetre and centigrade scales have been omitted.

It is intended ultimately to reproduce on the actual plates the small diagram charts at present incorporated in the text.. The large margin which is left at the side will receive these diagrams in future numbers.

The mode of reproduction of the instrumental records for the first three numbers of the Quarterly Weather Report for 1869 was by means of lithography. The traces on the zinc templates, furnished by Mr. Galton's pantagraph, were transferred to stone by an ordinary pantagraph.

The process followed for Part 4, Vol. I., and for the present number, has been to effect the complete reductions in the office by means of a Wagner's pantagraph. The zinc templates are copied by its means at a reduced scale on copper on an etching ground, and the copy is bitten in with acid. Proofs from these plates are then transferred to stone, and the published impressions are therefore still lithographs.

Arrangements are in progress for the speedy adoption of direct copperplate printing, which will insure much greater clearness than is attainable by the lithographic process.

Before quitting this branch of the subject, attention must be drawn to a serious difficulty which has been encountered and overcome in the process of reduction now adopted.

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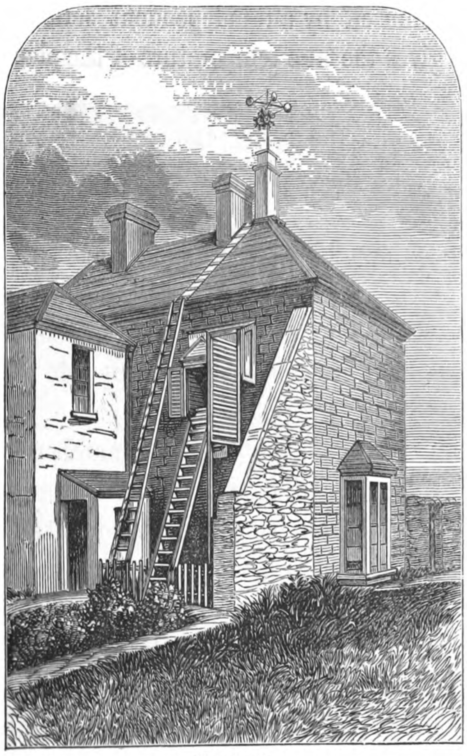
* Tables Psychrométriques et Barométriques, par A. T. Kupffer. St. Petersburg, 1841.

This difficulty arises from the fact that the photographic records not unfrequently exhibit traces of "bagging," apparently due, in great measure, to some effect of temperature, to counteract which adequate provision had not been made originally in devising the instruments. The result of this is that the fiducial lines of the photographs are sometimes curved to a slight extent. Allowance is made for this in making the original tabulations from the curves themselves, from which the numerical results are obtained, but of course the difficulty meets us again when we proceed to copy the record itself.

Careful experiments are being made to remove this source of uncertainty altogether, and meanwhile the requisite accuracy of the records is secured by frequent remeasurements of the proofs, comparison of the results with the original tabulations, and correction of the proof, whenever necessary, before it is finally signed for press.

An instrument is also being made, designed by Mr. Galton, to correct at once by mechanical means the fiducial lines of all the existing records in which this so-called "bagging" effect is noticeable.



Valencia.

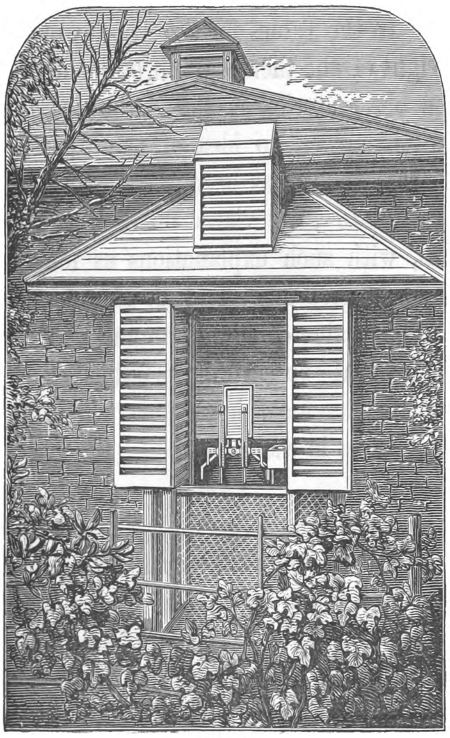
In this volume the Committee are glad to be able to supply some information which might with advantage have been given in Vol. I. In the Tables for the five-day means the height of the thermograph bulbs at each of the observatories is stated, but as this information gives no idea of the exposure of the screens, it has been resolved by the Committee to give views of each of the screens, with such explanations as may be required to give as correct an idea as possible of the value of the thermometrical and anemometrical observations published by them, and the local influences which may exert an effect in each case.

Valencia.—The observatory is situated close to the shore on the south side of the island, about three miles from the open sea. The anemograph is on the roof of the house, which is two stories high. Its exposure is fairly good, for although it is situated in a valley, with hills of the height of about 1,000 feet to the south and south-east of it at a distance of three miles, and with a slight hill about 700 feet high distant three-quarters of a mile on the north-west of it, the country towards the other points of the compass is quite open, and the situation for wind is as favourable as can be obtained on that very rugged coast. The only point from which the wind is materially deflected or checked by local influence is the north-west. The house is an ordinary dwelling house of small size. The thermograph is on its north side, facing due N.W. ½ N., and on the first story. The bulbs of the instruments are at a height of 12 feet above the ground, and about 20 feet above the sea level. The exposure is very good, as there are no buildings or trees in the vicinity to affect the readings.

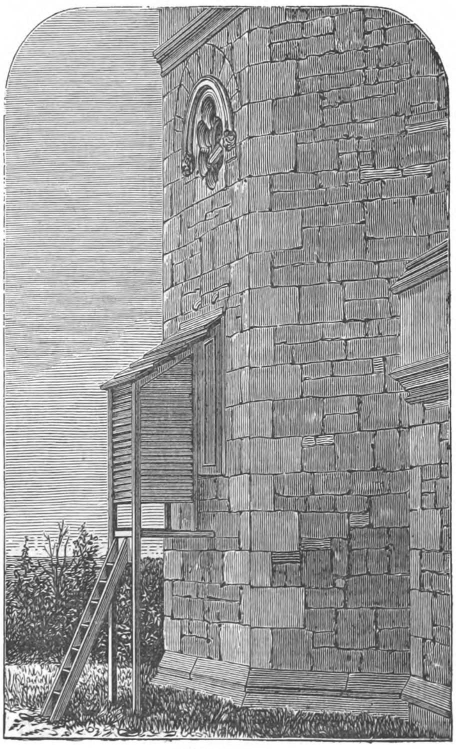
ARMAGH.—The observatory is on a rising ground close to the town; it is situated in the centre of an ordinary garden and pleasure ground, containing trees and shrubs of moderate size.

The anemograph is erected on the roof of the house, and raised 17 feet above it, and is thoroughly well exposed to all points, excepting that the country about is undulating and fairly well wooded, which has the effect of retarding the motion of the air.

The thermograph screen is erected on the north side of the meteorological observatory; the bulbs are at the distance of 4 feet from the ground, and about 206 feet above sea level. The exposure of the screen is good, though there are trees and shrubs about it. However, Dr. Robinson has satisfied himself by an independent series of observations that the record taken in the screen gives the true temperature of the place.



ARMAGH.



GLASGOW.

GLASGOW.—The instruments are at the astronomical observatory, which is placed on a slight rising ground at the west side of the town, and commands a clear view of the horizon in all directions. It occupies a central position in the valley of the

Clyde, which is about 16 miles in breadth at that place. The bounding hills to the north are about 800 feet in height, those towards the south are about 400 feet high.

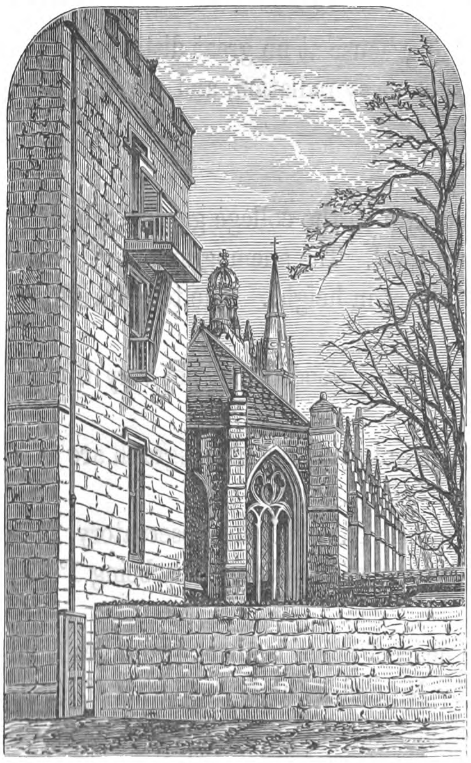
The prevailing south-westerly winds sweep along the estuary of the Clyde and reach the observatory without much interruption.

The exposure both of the anemograph and of the thermograph screen is very satisfactory. The former is on the roof of the building, the latter is attached to the north wall of the tower in which the equatoreal is placed. The bulbs are 7 feet above the ground, and about 190 feet above sea level.

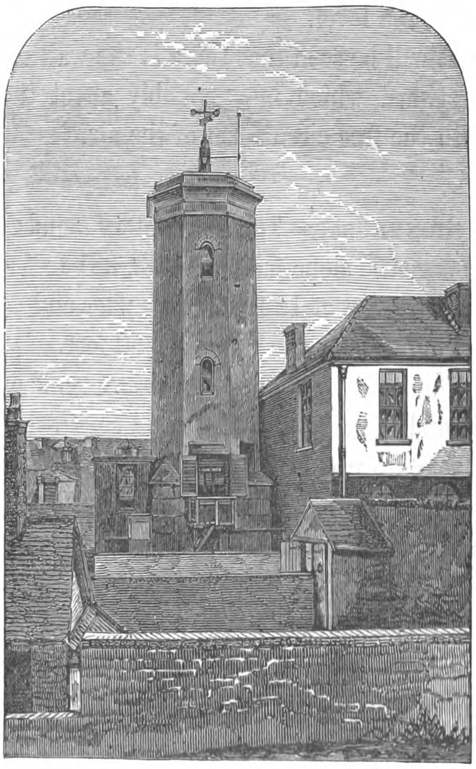
Aberdeen.—The observatory is at King's College in Old Aberdeen, and lies on a plane gradually rising from the sea, from which it is distant about a mile. There are no irregularities of surface in the vicinity, excepting the two river valleys of the Dee and Don, which are not of great importance. The ground immediately about the buildings is 46 feet above the mean sea level.

The anemograph is erected on the roof of the building, at a height of 72 feet from the ground. It is well exposed on all sides.

Great difficulties were encountered in obtaining a site for the thermograph screen. The north side of the college is almost entirely occupied by the chapel. One wall of the building in which the physical cabinet and lecture room are situated also affords a north aspect, but unfortunately there are trees growing at a short distance from it, which would entirely check the free circulation of air about the instruments were the screen set up at the usual elevation of about 6 feet above the ground.



Aberdeen.



Falmouth.

(Anemometer [illegible] built afterwards)

Accordingly the window on the second story of the building was selected. It affords a free exposure to the north, but is at a level of 41 feet above the ground, and about 87 feet above the sea level.

This elevation will of course exert a considerable influence on the thermometrical observations recorded.

FALMOUTH.—The establishment of an observatory at this station was beset with considerable difficulties; the building in which the Royal Cornwall Polytechnic Society holds its meetings was unsuited to the purposes of a meteorological station. Accordingly a tower was erected at the south-east corner of the bowling green on the top of one of the hills on which the town is built.

The anemograph is on the summit of the tower, well exposed on all sides; but from the fact that the ground in the neighbourhood is uneven, the hill sloping rapidly down to the harbour, it seems probable that the force of the wind is not quite true, especially when it is easterly.

The position of the thermograph screen is far from being quite satisfactory, however, a better exposure could not be obtained. The screen is attached to the north wall of the tower, at an elevation of 11 feet above the ground, and about 200 feet above sea level.

It will be seen that there is the wall of a dwelling house at no great distance to the westward, which may possibly affect the instrument by radiation, and also interfere with the free circulation of the air.

STONYHURST.—The observatory stands in the centre of the college garden, which is on a gentle slope facing S.S.E., 381 feet above sea level. The anemograph stands on a cylindrical roof 12 feet in diameter and 4 feet 5 inches in height. The total height of the cups above the ground is 30 feet.

The country around, including the college grounds, is wooded, but not very thickly so, and the trees are in general small.

The nearest trees whose height could materially influence the anemograph are at a distance of about 200 yards, bearing from N. by W. to N. by E.

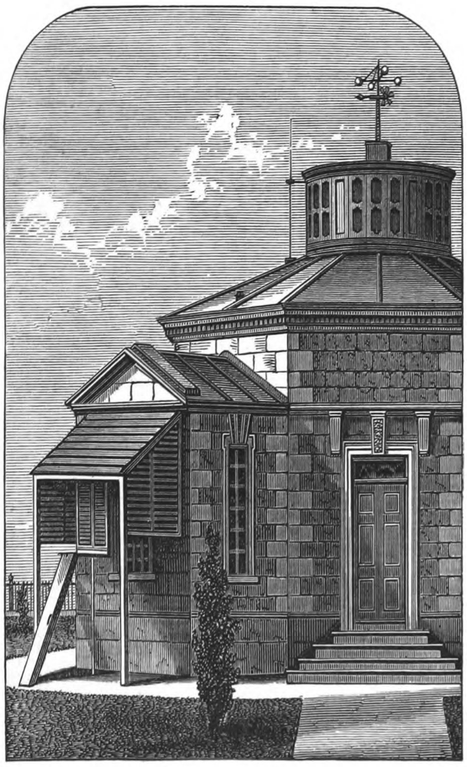
The main building of the college is placed at the N.W. of the observatory, at a distance of 193 yards, its angular height above the roof of the observatory being 1° 37′, and bearings from N. by W. to W.N.W.

The nearest hill is the Longridge Fell, whose nearest point is about two miles from the college. It extends from N. by W. to W. by N., and its highest point is 4° 1′.

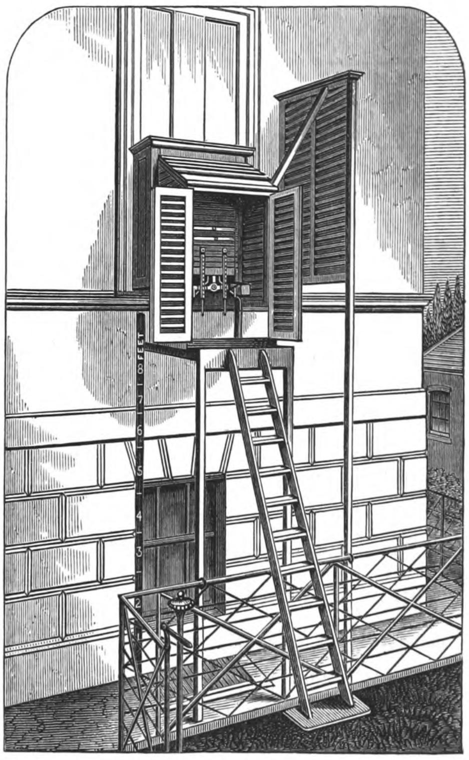
Pendle Hill is at five and a half miles distance E.N.E.; height 2° 5′. Between these hills the country is very open. To the eastward there are hills at about four miles distance, height about 1°. To the S. and S.W. the land is low.

It will be seen from this that the anemograph is fairly well exposed to the different points of the compass.

The thermograph screen is attached to the north wall of the observatory, the bulbs are at an elevation of 7 feet above the ground. The exposure is good.



STONYHURST.



KEW.

KEW.—The observatory is situated in the old Deer Park at Richmond. It is a small building, which is well exposed to the wind, excepting on the west side, where there is a row of trees distant about 150 yards, which must materially affect the velocity of the wind. The country about is also well wooded.

The anemograph is placed on the dome.

The thermograph screen is attached to the north wall of the observatory within 10 feet of the west end of that wall, at a height of 10 feet above the ground, and about 50 above sea level. Its exposure is good.

QUARTERLY WEATHER REPORT,

1870.

Jan. 1. The year commenced with a general deficiency of atmospherical pressure, as we see from Plate I. that all the barograms start from a height of about 29 inches. All the telegraphic stations, except those in the extreme north, reported a decrease at 8 a.m. from the readings taken on the previous morning. Owing to the general uniformity in pressure the wind was light; its direction was southerly over these islands and in France, where, however, it was fresher than with us. In Norway a moderate easterly breeze was felt. The weather was cloudy and rather wet. The barograms show a further fall at all the observatories except Aberdeen until the afternoon, but then a steady increase set in, and the mercury remained nearly steady for about 24 hours from midday on the 2nd. A thick fog was reported in the Irish Sea during the evening, and at night a bright aurora was observed at Markree Observatory, near Sligo, and at Sandwick.

Jan. 3. At noon a sudden decrease is shown in the barogram for Valencia, which passed eastwards during the course of the next day, causing a slight S.W. gale in the south of Ireland and on the Welsh coast, which, however, did not extend beyond Falmouth. It was accompanied by hail-squalls, and thunder at the Irish stations, with an aurora at Guernsey.

Observatories, Jan. 1870.	VELOCITY. 30-40 Miles per Hour.		VELOCITY. Exceeding 40 Miles per Hour.				VELOCITY. Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	MAXIMUM VELOCITY.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	1 p.m. (3rd).	S.S.E.	2 a.m. (4th).	S. by W.	43	5	Noon (4th)	S.W.	23	7 a.m. (4th).	S.W by W.	50	Sudden lull to 19 miles (10 a.m. 4th). At 3 p.m. of the 4th the wind had backed to S.E. by S. again.
Armagh -	—	—	—	—	—	—	—	—	—	3 p.m. (4th).	S.S.W.	32	—
Orkney -	6 a.m. (4th).	S.E. by E.	—	—	—	—	10 a.m. (4th)	S.E. by S.	4	10 a.m. (4th).	S.E. by S.	32	—
Falmouth -	8 p.m. (3rd).	S. by W.	—	—	—	—	10 a.m. (4th)	S.W.	14	10 p.m. (3rd.)	S. by W.	32	—
Holyhead -	6 p.m. (3rd).	S.	9 p.m. (3rd). 8 a.m. (4th).	S. by E. S.W. by S.	40 43	5 7	6 p.m. (4th)	S.W.	24	1 p.m. (4th).	S.W.	48	—

Jan. 6. The barograms, Plate II., show a general decrease in pressure at all the stations, and at Holyhead a strong breeze from S.W. had already set in at midnight on the 5th, and lasted throughout the day, reaching the velocity of a gale for a few hours in the afternoon. This breeze was hardly felt elsewhere, except at Ardrossan, where it was reported at midnight. This small oscillation of the barometer was only the precursor of the far more serious disturbance which succeeded it on the 8th.

The barometer at the Norwegian stations had been falling steadily during the three preceding days, so that when the independent depression of which we have just been speaking had advanced to Aberdeen, on the morning of the 7th, it apparently became merged in the more extensive area of reduced pressure which had by that time formed itself over Scandinavia, as the daily reports from that district show but slight traces of its passage eastwards from Scotland.

Fig. 1 for the 7th shows us that readings decreased uniformly to the extent of an inch between Rochefort and the north of Scotland. The gradients being uniform and of moderate steepness, the wind was fresh from the westward, but nowhere amounted to a gale.

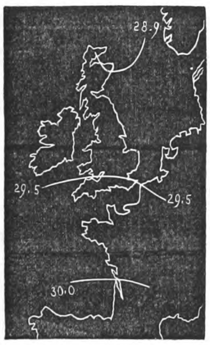


Fig. 1. Jan. 7.

At 9 a.m. the barometer at Valencia began to fall very rapidly; the wind increased to a strong gale from S.E. by E. at 2 p.m., and a serious depression traversed the United Kingdom, moving with great rapidity, the minimum readings for the month being registered at all the observatories within 12 hours of each other. The hollow was recorded at Valencia at 1 a.m. on the 8th, and it passed over Kew and Aberdeen about noon. The absolute lowest reading recorded, when reduced, was 28·49 in., which was observed at Armagh, at 5 a.m. The minimum at the other three northern observatories ranged about 0·1 in. higher. At Falmouth and Kew the mercury did not fall below 29 in. at all. The rise subsequent to the passage of the minimum was especially brisk in the west, and accordingly Fig. 2 for the 8th shows us an area of readings below 28·6, embracing the south of Scotland and the Irish Sea, while to the southward readings are much higher, and the gradient of 19 exists between Rochefort and Pembroke, and even that of 29 between Plymouth and Pembroke! As might be expected, a very severe westerly storm is raging at all our southern stations, and on the north coast of France.

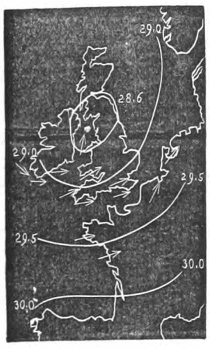


Fig. 2. Jan. 8.

The subjoined Table and Plate II. prove that the gale was not felt in the north of Ireland or in Scotland, as readings in the north were uniformly low, so that nothing but a moderate easterly breeze was felt. Nor did it affect the Norwegian stations, where, as well as in Russia, the wind was moderate from S.E. and E. It, however, swept along the south coast of the North Sea, and reached Hamburg in the afternoon, lasting at that station for 24 hours, and averaging more than 50 miles an hour during the night of the 8th and 9th.

Observatories, Jan. 7th.	VELOCITY. 30–40 Miles per Hour.		VELOCITY. Exceeding 40 Miles per Hour.				VELOCITY Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	MAXIMUM VELOCITY.			Remarks.
	Com-menced.	Direction of Wind.	Com-menced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	1 p.m. (7th).	S.E. by E.	2 p.m. (7th).	S.E. by E.	50	17	8 a.m. (8th)	W. by N.	19	9 p.m. (7th).	S.	64	—
Falmouth -	3 p.m. (7th).	S.W. by S.	4 p.m. (7th).	S.W.	52	22	4 p.m. (8th)	W.	25	7 a.m. (8th).	S.W.	66	—
Holyhead -	7 p.m. (7th).	S.S.E.	9 p.m. (7th).	S.S.W.	44	13	9 p.m. (8th)	W.	26	3 & 4 a.m. (8th).	S.S.W.	57	—
Stonyhurst -	2 a.m. (8th).	S.W. by S.	4 a.m. (8th).	S. by W.	41	2	8 a.m. (8th)	S. by W.	6	6 a.m. (8th).	S.	42	—
Kew - -	11 p.m. (7th).	S.W.	7 a.m. (8th).	S.W. by S.	44	9	6 p.m. (8th)	S. by W.	19	11 a.m. & noon (8th).	S.W. by S.	50	—
Yarmouth -	8 a.m. (8th).	S. by W.	—	—	—	—	8 p.m. (8th)	S.W. by W.	12	noon (8th).	S.S.W.	40	—

On our own coasts the gale was fortunately of short duration, ceasing at Valencia at 8 a.m. on the 8th. Its violence was very considerable while it lasted, the hourly velocity at Valencia and Falmouth exceeding 60 miles, and at Kew reaching 50, a figure which it had never once attained during the whole of the year 1869. The storm was accompanied by heavy rain at the Irish stations, and at Liverpool a thunderstorm was reported at 3 a.m. on the 8th. At night aurora was reported from Cork, Dublin, and Holyhead.

The only ship from which we have obtained an account of this gale is the "City of Brooklyn," Capt. Brooks, which was off the S.W. coast of Ireland, outward bound. It lasted with her up to 4 a.m. on the 9th, much longer than it did at Valencia.

The barograms show that a rapid increase set in immediately after the registration of the lowest barometrical reading, and by 8 a.m. on the 9th, the rise over the district where the centre of depression had existed on the previous day exceeded 0·8 in., so that we find the depression situated over the south of Norway on Fig. 3, the only gales reported being from W.N.W. on the west coast of England, where they lasted until the evening at Falmouth and Holyhead, even reaching the velocity of 50 miles an hour at the latter station at noon. In France and over the Bay of Biscay the wind was fresh from S.W. and W., blowing hard both at Rochefort and Corunna.

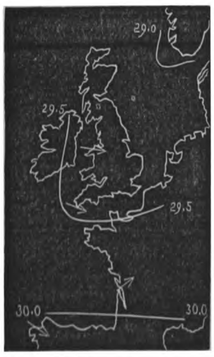


Fig. 3. Jan. 9.

Jan. 10. The only occurrence specially noticeable on our records for this day is a slight depression which passed over Valencia and Falmouth in the morning, Plate II., but a more important disturbance advanced to the west coast of France, causing stiff S.W. gales at Corunna and Biarritz. It did not affect our stations in the slightest degree, and our winds continued, for the most part, light from the northward, being apparently affected by the low pressures prevailing over Scandinavia.

Jan. 11. A decrease of pressure set in at all the observatories on this day. It was of far greater magnitude in the north than elsewhere, and its character at Valencia and Falmouth was entirely different from that which it exhibited at the Scotch observatories, so that the two disturbances were probably more or less independent of each other.

The southern one was accompanied by a very rapid rise of temperature and a considerable freshening of wind from the westward, which, however, only extended to Falmouth and Holyhead. It was soon succeeded by a gale of somewhat greater force, as is shown by the instrumental records for the next day.

Observatories.	Velocity, 30-40 Miles per Hour.		Velocity, Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	1 am. (12th).	W.N.W.	—	—	—	—	1 p.m. (12th)	W.	12	3 a.m. (12th).	W.	37	—
Aberdeen -	6 p.m. (12th).	W. by S.	8 p.m. (12th).	W. by N.	41	4	Midnight (12th).	N.W.	6	11 p.m. (12th).	N.W. by W.	50	—
Sandwick -	11 p.m. (11th).	S.W.byW.	1 a.m. (12th).	W.S.W.	46	10	10 a.m.(12th)	S.W.	11	9 a.m. (12th).	S.W.	51	—
Falmouth -	3 a.m. (12th).	W.S.W.	—	—	—	—	2 p.m. (12th)	W.N.W.	11	11 a.m. (12th).	W.N.W.	39	—
Holyhead -	1 a.m. (12th).	W. by S.	—	—	—	—	2 a.m. (13th)	W. by N.	25	8 p.m. (12th).	W. by N.	41	This velocity only for one hour.

This table and Plate III. show us that the short gale which was felt at Aberdeen was distinct from all the others, and it was accompanied by a special oscillation of the barometer which appears at no other station.

The disturbance seems to have passed away in a south-easterly direction, for a fresh S.W. gale was felt at Hamburg during the night of the 12th. The weather throughout the day was squally in these islands, with snow and hail showers at many of our stations. A thunderstorm was reported from Guernsey, and lightning at several of our southern stations.

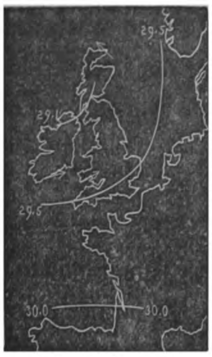


Fig. 4. Jan. 14.

Jan. 13. A steady fall of the barometer was in progress at Valencia all day long, while in Scotland the mercury was rising very briskly during the morning hours, especially at Aberdeen. At noon, however, pressure began to give way at these stations too, and during the course of the next day a broad depression passed over all the observatories. Fig. 4, for the 14th, exhibits the lowest readings situated off the north coast of Ireland, while a westerly gale is blowing in the south of that island and one from E.S.E. in the Pentland Firth. The reading at Greencastle is more than an inch below those in Spain. The centre of disturbance seems to have moved across the north of England. The only point deserving special notice in the photographic records is the sudden reduction of temperature which appears at Stonyhurst, and which only lasted from 3 to 6 p.m. It was associated with a slight shift of wind from S.S.W. to S.W., accompanied by a diminution of its velocity which is, to the full, as remarkable as the oscillation of temperature.

The anemometrical records show that the force of the wind was not very serious; as the gale hardly extended beyond our western coasts. The remarkably sudden cessation of the wind at Aberdeen on the 14th, Plate III., is well worthy of note.

Observatories, Jan. 13-14, 1870.	Velocity, 30-40 Miles per Hour.		Velocity, Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	6 a.m. (13th).	S.E. by E.	11 p.m. (13th).	S.S.W.	41	8	8 p.m. (14th)	W. by S.	38	7 a.m. (14th).	S.W.	44	A velocity of 40 miles was reached several times on 13th, but only in gusts.
Armagh -	—	—	—	—	—	—	—	—	—	7 p.m. (13th).	S.W.	31	—
Aberdeen -	11 p.m. (13th).	S. by E.	—	—	—	—	7 a.m. (14th)	S.S.E.	8	3 a.m. (14th).	S.S.E.	37	—
Sandwick -	9 p.m. (13th).	E.S.E.	5 a.m. (14th).	S.E. by E.	42	6	6 p.m. (14th)	E. by N.	21	10 a.m. (14th).	E. by S.	44	—
Falmouth -	9 p.m. (13th).	S.W. by S.	—	—	—	—	7 p.m. (14th)	W.	22	1 p.m. (14th).	W. by S.	43	—
Holyhead -	6 p.m. (13th).	S.E. by S.	11 p.m. (14th).	W.S.W.	43	4	3 a.m. (15th)	W.	33	3 a.m. (15th).	W.	44	—

The weather was wet and foggy on our south-west coast during the 14th, with occasional hail showers in the south of Ireland. The only vessels from which we have accounts of the gale were the "Palmyra," Capt. Watson, and the "Patagonia," Capt. Petrie. There is nothing specially remarkable in their logs; they were in a lower latitude than Valencia, so that the gale with them shifted to the northward of West, as it did at Cape Clear, whereas at Valencia it died down at W. by S.

Jan. 15. A steady rise of the barometer set in at all our stations, and a similar change was reported in the north of Finland, where light easterly winds were reported with very cold weather. On our own coasts the wind was light from the westward, and the only relics of the gale, which had just passed over, were strong northerly winds which were reported from Oxö and Sandosund, in the south of Norway. The equatorial current gradually lost its force, and was displaced by the polar in the course of the next few days, so that the weather became uniformly cold.

Jan. 18. The barometrical reading of 30·9 ins. was registered at both Haparanda and Hernosand, in the Gulf of Bothnia, with a temperature of −22° F. at the former place. The easterly wind was blowing freshly over Norway, and had extended to our own south-east coast, causing a depression of temperature and a very dense fog at many stations. At all our observatories, except Valencia, the highest barometrical readings for the month were recorded on this day and the next, and at those in the south of England the decrease of pressure had set in by midnight on the 18th, while at the same time the area of high pressure had advanced in a south-westerly direction to the south of Norway, so that an anti-cyclonic movement was developed in the air over the west of Europe on the 20th, the wind sweeping from N. and N.E. over the Baltic, to E. over France and our southern coasts, and to S. and S.W. at Sandwick and in the north of Norway, where a S.W. gale was reported at Christiansund and Bodö, in fact nearly up to the North Cape.

On our own coasts the only place where a strong wind was felt was at Yarmouth, where a stiff breeze from E. had begun at 6 a.m. on the 19th, and lasted for 41 hours, attaining the force of a gale for 18 hours from 1 p.m. on the 19th. Fog was still reported as very prevalent.

Jan. 21. The high pressures in Scandinavia had given way and the area of maximum readings lay over Ireland, conditions which remained unchanged until the 24th, when an area of depression made its appearance in the north of Russia, causing the wind to draw into North and freshen over Norway and Sweden with very cold weather. The effect of this disturbance did not last long as the depression passed off southwards.

In these islands a gradual reduction of pressure appeared on the 25th, on which day also a sudden fall of temperature is observable. The barometer fell most rapidly in the west while readings remained high over England, so that a fresh southerly breeze set in on the south coast of Ireland on the 26th, extended to the west of Scotland next day, and increased to the force of a gale at Valencia before midnight on the 27th, as appears from the table on p. 8. Aurora was reported from Sandwick on the 26th.

The cause of the serious reduction of temperature on our eastern coasts on the 26th and 27th is to be found in the fact that the barometrical depression already noticed had advanced southwards over the north of Russia on that day and the next, causing the winds over the North Sea to draw into N.W. The easterly winds over France were undisturbed.

Jan. 28. Fig. 5 shows us that the isobar of 29·9 runs nearly due N.E. from Cork to Skudesnaes. The gradient from Pembroke to Valencia was 6, so that a southerly gale was reported from all the stations in the south of Ireland, while in St. George's Channel also the wind was fresh from the same quarter. Matters were not much changed by the 29th, as we see from Fig. 6, where the gale is shown in precisely the same district as on the previous day. Weather continued foggy on our east coast, and Mr. Clouston reports aurora again, which had continued for four successive nights.

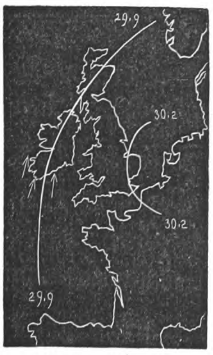


Fig. 5. Jan. 28.

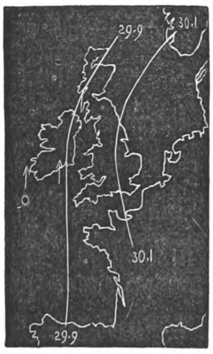


Fig. 6. Jan. 29.

Temperature had hitherto remained steadily low, so that hardly any rain was reported. This may possibly account for the remarkable fact that the gale was so strictly confined to the same stations for two days. The five-day mean for Kew for the 26th–30th of Jan. was as much at 11° 8′ below the average.

Jan. 30. We see from Plate VI. that the decrease of pressure became more rapid on this day at all the stations, and Fig. 7 exhibits the area of least readings in the same place as before, but the actual readings in Ireland are about 0·3 in. lower than they were. Gradients have increased over the south of England, and as the thermometer has at last begun to rise on the Channel coast, the gale has advanced to the western stations of England. At noon it ceased at Valencia, and by 8 a.m. on the 31st, Fig. 8, the only stations at which it was still reported were Holyhead, and those in the extreme north of Scotland. At Sandwick it lasted all through the day up to 3 a.m. on the 1st of February.

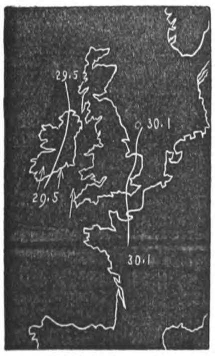


Fig. 7. Jan. 30.

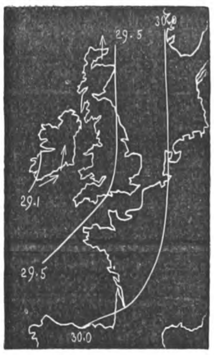


Fig. 8. Jan. 31.

The equatorial current made its way over France on the 29th and 30th, and on the 31st the winds were southerly all over Western Europe up to the coast of Norway, where their direction was south-easterly. The observatory records for the time we have just been discussing are as follows:—

Observatories, Jan. 28, 1870.	Velocity. 30–40 Miles per Hour.		Velocity. Exceeding 40 Miles per Hour.				Velocity. Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	4 p.m. (27th).	S.E. by S.	11 p.m. (27th). Midngt. (29th).	S.S.E. S.E.	43 52	40 11	Noon (30th)	S.S.E.	68	8 a.m. (30th).	S.S.E.	57	—
Armagh -	2 a.m. (30th).	S.E. by S.	—	—	—	—	3 a.m. (31st)	S.E. by S.	25	Midnight (30th).	S.E. by S.	44	—
Glasgow -	—	—	—	—	—	—	—	—	—	1 p.m. (30th).	S.E.	35	—
Aberdeen -	5 p.m. (30th).	S. by E.	—	—	—	—	2 p.m. (31st)	S.S.E.	21	11 a.m. (31st).	S.S.E.	37	—
Sandwick -	9 p.m. (29th).	S.	9 a.m. (30th).	S.S.E.	47	31	3 a.m. (1st) Feb.	S.	54	10 a.m. (31st).	S.S.E.	56	—
Falmouth -	3 a.m. (30th).	S. by E.	2 p.m. (30th).	S.S.E.	45	11	2 a.m. (31st)	S.	23	7 p.m. (30th).	S.S.E.	50	Strong breezes began on 26th, and continually exceeded 30 miles per hour, but there was scarcely a gale.
Holyhead -	6 a.m. (28th).	S. by E.	—	—	—	—	5 a.m. (29th)	S.S.E.	23	Noon (28th).	S.S.E.	40	—
	11 p.m. (29th).	S.E. by S.	2 a.m. (30th).	S.S.E.	49	33	10 p.m. (31st)	S.W.	47	3 a.m. (31st).	S.E. by S.	55	—
Stonyhurst -	—	—	—	—	—	—	—	—	—	2 p.m. (30th).	S.S.E.	29	—
Yarmouth -	7 p.m. (30th).	S.E. by S.	—	—	—	—	Noon (31st)	S.E. by S.	17	8 a.m. (31st).	S.E. by S.	38	—

Throughout this whole period light easterly winds were experienced over the south of Norway, but in the far north again, in Finmark, south-westerly breezes were felt.

Rain had at last set in in these islands on the 30th, on which day the fall at Valencia exceeded an inch.

Plate VII. shows us that the barometer reached its lowest point at Valencia at about 1 a.m. on the 31st, and then remained steady until 8 a.m., when a rapid rise set in. The barograms for the three northern observatories bear a pretty close resemblance to that at Valencia. At Aberdeen the increase was not observed until 2 a.m. next morning, and was much more limited in its extent. At Falmouth and Kew the rise of the barometer almost immediately succeeded the fall, as no trace of the remarkable steadiness of pressure, when at its lowest level, is noticeable there as it was at the other observatories.

Feb. 1. The mercury began to fall again in the west soon after midnight, the wind backing gradually to south, and the gale recommenced at 5 a.m. at Valencia. At 8 a.m. the isobars ran N.N.E. and S.S.W. across the United Kingdom, the southerly gale being only felt in Ireland, while in the south of Norway it had come on to blow hard from the eastward. Over Russia the barometer was high, with light winds.

This disturbance swept quickly over our stations, as the subjoined table shows. It was felt everywhere except in the south-east, but was not of serious consequence :—

Observatories, February 1870.	Velocity. 30–40 Miles per Hour.		Velocity. Exceeding 40 Miles per Hour.				Velocity. Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	1 a.m. (1st).	S.S.W.	5 a.m. (1st).	S. by E.	48	7	5 p.m. (1st)	S.S.W.	17	9 a.m. (1st).	S.S.E.	52	—
Armagh -	Noon (1st).	S.S.E.	—	—	—	—	3 p.m. (1st)	S. by E.	3	2 p.m. (1st).	S. by E.	37	—
Glasgow -	4 p.m. (1st).	S.E.	—	—	—	—	10 p.m. (1st)	S.E. by S.	6	7 p.m. (1st).	S.S.E.	40	—
Aberdeen -	—	—	—	—	—	—	—	—	—	7 p.m. (1st).	S. by E.	33	The velocity only reached 30 miles for 4 hours.
Sandwick -	1 p.m. (1st).	S. by E.	5 p.m. (1st).	S.S.E.	43	5	3 a.m. (2nd)	S. by E.	14	7 p.m. (1st).	S.E. by S.	46	—
Falmouth -	10 a.m. (1st).	S. by W.	3 p.m. (1st).	S. by W.	43	7	Midnight (1st).	S.W. by S.	14	9 p.m. (1st).	S. by W.	45	—
Holyhead -	9 a.m. (1st).	S.S.E.	11 a.m. (1st).	S.S.E.	47	11	Midnight (1st).	S.	15	6–7 p.m. (1st).	S. by E.	51	A velocity of 30 miles is recorded for 4 hours on the 2nd.
Stonyhurst -	5 p.m. (1st).	S. by W.	—	—	—	—	3 a.m. (2nd)	S.	10	9 p.m. (1st).	S.	37	—
Kew - -	—	—	—	—	—	—	—	—	—	10 p.m. (1st).	S. by W.	29	—
Yarmouth -	—	—	—	—	—	—	—	—	—	10 p.m. (1st).	S.	25	From 5 a.m. to 8 a.m. on the 2nd, the S. wind reached 30 miles.

A bright aurora was seen at the Irish stations in the evening, the observer at Roche's Point reporting "most remarkable belts of light from E. to W., 7 to 10 p.m." These luminous clouds were also seen in London. Stockholm too reports an aurora.

Weather remained calm, with southerly winds, in the British Islands for the next few days. The easterly winds still continued to blow on the west coast of Norway, though with somewhat less force than they had previously possessed. On the 3rd, however, the barometer had risen to a height of 30·6 ins. in Central Russia, with a temperature of – 21° F. at Moscow, light easterly winds and a clear sky; a state of things which was destined to exercise a great influence on our weather for the next fortnight.

Feb. 4. On Fig. 9 we notice a small area of low readings in the south-west of Ireland, while the isobar of 29·8 runs nearly due north from Biarritz to Skudesnaes. The effect of this disturbance on the wind was insignificant, except at Sandwick where a strong S.E. breeze was felt all day long. The depression died out as it travelled eastwards. Meanwhile the excess of pressure in Russia was becoming more serious, and the barometer at St. Petersburg rose to the height of 30·7 in. at 8 a.m., with a temperature of – 28°. In the afternoon the easterly winds freshened again in Norway, and extended to Hamburg, where, however, the gale only lasted through the night.

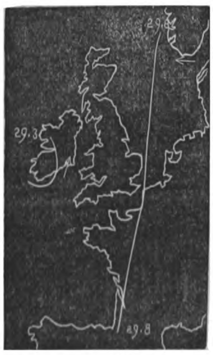


Fig. 9. Feb. 4.

Feb. 5. Neither the daily chart nor the barograms, Plate VIII., show any very serious sign of disturbance at 8 a.m. The barometer at all our stations was rising briskly, and at St. Petersburg it had risen still further, the mean for the day at that station being 30·988 in.* All this time a most serious depression was existing over the Atlantic, at a distance of less than 500 miles from the Irish coast, with a furious gale which was experienced by the "Tarifa," the "City of Cork," and the "Weser."†

At noon the barometer at Valencia began to fall, and the wind speedily rose to a gale from S.S.E.

The shift of wind from N.W. to S.E., at which point it lulled before the gale began, is confirmed by the log of the S.S. "Nestorian," outward-bound, which was off the north-west coast of Ireland. She had the wind fresh from W.N.W. at 8 a.m., and at 2 p.m. it backed to S. by E., and the gale began at 3, an hour later than it had set in at Valencia.

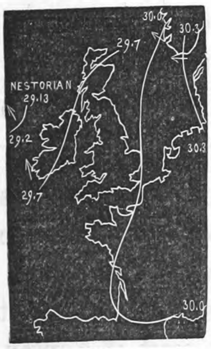


Fig. 10. Feb. 5, 6 p.m.

Fig. 10., for 6 p.m. on the 5th, proves that although there is not much sign of disturbance in barometrical readings over these islands, the depression is not far from our coasts. The lowest reading at our stations is 29·59 in. at Valencia, while on board the "Nestorian," Capt. A. D. Aird, in 55° 13′ N. and 13° 39′ W., the mercury reads 29·13. About the same time the "Tarifa," Capt. Michael Murphy, the "City of "Cork," Capt. R. A. Allen, and the "Weser," Capt. G. Wenke, which were all about on the meridian of 25° W., report readings below 28 inches, with a terrific westerly gale, during which the "Weser" had to heave-to for five hours. On board the "Tarifa" the barometer fell *nearly two inches in* 10 *hours*, from 29·256 at 8 a.m., to 27·400 (unreduced) at 6 p.m. (local time). Capt. Allen, in the "City of Cork," reports a fall of 0·68 in. in one hour, from noon to 1 p.m. (local time)!! The absolute minimum recorded was that just given for the "Tarifa," which, when corrected and reduced to sea level, becomes 27·33 in., a reading almost unheard of in these latitudes; and as at the same hour the reading at St. Petersburg was above 30·99 in., it is safe to conclude that there was at that hour, 7.30 p.m., Greenwich time, *an absolute difference in atmospherical pressure amounting to* 3·7 *in. of mercury between these two points*, distant from each other about 1,950 geographical miles. A disturbance of atmospherical equilibrium on such a gigantic scale is very remarkable.

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* Extract from a letter from Lieut. Rikatcheff, of St. Petersburg:—

"It will perhaps be interesting for you to know that, on the 5th of February 1870, we had at our observa-" tory the mean of 24 hourly observations 787·1 m.m. At midnight 5th and 6th we had 789·1, and on the " next day the maximum was 790·3 m.m. about 10 a.m."

† For the log of this vessel, and of others belonging to Hamburg, I am indebted to the kindness of Herr W. von Freeden, director of the Norddeutsche Seewarte at Hamburg.

The facts appear to show that the gale which ensued on our coasts was to the full as much to be attributed to the advance of the high pressure westwards from Russia as to that of the low pressure eastwards from the Atlantic. In fact the latter never reached our shores at all, for although the "Nestorian," on the morning of the 6th, in the latitude of Greencastle, and in 16° W., reports a reading of 28·25 in., the lowest reading recorded by our barograms was about 29 in. at Armagh, so that the deficiency of pressure had been reduced nearly to the extent of two inches between the meridian of 25° W. and our coast.

About midnight the gale commenced from S.E. at Holyhead, Armagh, and Sandwick, and a fresh breeze from S. was felt at Falmouth. At Armagh the gale only lasted for 13 hours, but at Sandwick for three days.

Feb. 6, Fig. 11, exhibits the isobars running nearly due north and south. The barometer has fallen 0·4 in. at Valencia, while a rise is reported from all the eastern stations. The gradient across the North Sea is as much as 12·5 from Oxö to Nairn, and that from Pembroke to Cape Clear is not much less, being 10. We need, therefore, feel no surprise when we see that a furious S.S.E. gale had set in on the north coast of Scotland, averaging nearly 60 miles an hour at Sandwick from 4 a.m., and reaching its maximum of 70 miles an hour at 10 a.m. Along St. George's Channel, too, the force of the gale was not much less.

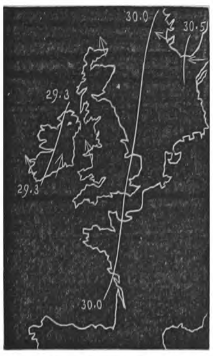

Fig. 11. Feb. 6, 8 a.m.

The fact which made this storm specially destructive on the north-east coast of Scotland, was that owing to the long continuance of strong east winds on the eastern shores of the German Ocean a very heavy sea had been produced, which when it reached our shores inflicted great damage on the harbour works at Wick.

It is well worthy of remark that during this entire period the winds reported from the stations in the south-west of Norway were easterly, and were nearly at right angles to the direction of the isobars, as will be seen from Figs. 10–13. The discordance between this direction of the wind and that which would have been expected in accordance with Buys Ballot's law is to be attributed to the fact that there is so much high land near the coast of Norway that it is not possible to obtain perfectly trustworthy observations of wind, either as to direction or force.

The Table shows that the gale extended to all the stations except Kew and Yarmouth.

Observatories, February.	Velocity, 30-40 Miles per Hour.		Velocity, Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours, the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	1 p.m. (5th).	S.E. by S.	3 p.m. (5th).	S.S.E.	49	16	5 p.m. (6th)	S. by W.	28	5 & 6 a.m. (6th).	S.S.E.	55	—
Armagh -	10 p.m. (5th).	S.E.	5 a.m. (6th).	S.E.	42	4	11 a.m. (6th)	S.S.E.	13	9 a.m. (6th):	S.E.	47	—
Glasgow -	10 a.m. (6th).	S.E. by E.	—	—	—	—	9 p.m. (6th)	S.E. by E.	11	Noon (6th).	S.E. by E.	42	Repeated squalls until 2 a.m. (7th).
Aberdeen -	6 a.m. (6th).	S.S.E.	8 a.m. (6th).	S.S.E.	46	19	4 a.m. (7th)	S. by E.	22	5 p.m. (6th).	S.S.E.	55	—
Sandwick -	11 p.m. (5th).	S. by E.	4 a.m. (6th.)	S.E. by S.	58	26	6 a.m. (7th)	S.S.E.	31	10 a.m. (6th).	S.E. by S.	70	The S.E. wind freshened to a velocity exceeding 30 miles about 9 a.m. (4th), & having reached a maximum of 40 at 7 p.m., gradually went down at 7 a.m. (5th).
Falmouth -	11 p.m. (5th).	S.	10 a.m. (6th).	S. by E.	41	7	6 p.m. (6th)	S.S.W.	19	11 a.m. (6th).	S. by E.	43	—
Holyhead -	10 p.m. (5th).	S.S.E.	1 a.m. (6th).	S.S.E.	52	21	1 a.m. (7th)	S. by W.	27	10 a.m. (6th)·	S.E. by S.	63	The S.E. wind freshened, and exceeded 30 miles at 10 p.m. (3rd). The maximum was 46 miles at 6 p.m. (4th), and at 8 p.m. the velocity fell below 30 again.
Stonyhurst -	3 p.m. (6th).	S.E. by S.	--	—	—	—	Mid. (6th)	S.	9	9 p.m. (6 th).	S.S.E,	39	—

From the barograms, Plate VIII., we see that a distinct depression passed to the eastward in the course of the 6th, and the early hours of the 7th, over all the observatories, except Kew. It is remarkable that very slight traces of this entire disturbance are noticeable in the reports from Norway, while at St. Petersburg the barometer had continued to rise, and reached its maximum of 31·14 ins. (when reduced) at 10 a.m. on the 6th. A recovery set in at most of our stations immediately after the registry of the lowest reading. This was much more brisk in the north than elsewhere; in fact at Kew it is imperceptible, and at Falmouth very slight. At these two latter stations the barometer continued to fall during the 6th, so that the chart for 8 a.m. on the 7th, Fig. 12, exhibits a great contrast to the course of the isobars on the preceding day; an area of low pressure stretching from Valencia to Penzance, while over the North Sea the lines still run from north to south.

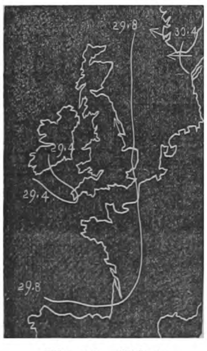

Fig. 12. Feb. 7.

The wind had moderated at all of our stations except a few on the east coast, where a S.S.E. gale was reported from Scarborough. At Yarmouth a similar gale had commenced on the evening of the 6th, and it lasted, with little intermission, from S.E. and E. for *nine successive days.* It averaged 45 miles an hour for upwards of 30 hours from 10 a.m. on this day.

At the Norwegian stations the force of the wind had increased considerably, and it even extended northwards to Christiansund. During the day the gale recommenced along the east coast of Scotland, and in the afternoon, from about 4 p.m., it averaged 46 miles an hour, and maintained it for 28 hours at Aberdeen, and for 30 at Sandwick.

It will be seen from Plate VIII. that no strong winds were felt at any other of our stations but Valencia and Glasgow, where, however, there was nothing which could be called a gale. The "Hammonia," Capt. Meier, and the "Carl Georg," Capt. Arfmann, which were off the S.W. coast of Ireland, reported a stiff westerly gale for a short time. The maximum force of the wind was registered on the morning of the 8th at all the stations on the east coast, but it was not nearly so high as it had been on the 6th.

Pressure continued to decrease at the Channel stations during the 7th, and a distinct minimum is noticeable at Falmouth shortly before 3 a.m., on the 8th, subsequent to which a brisk rise set in, which had the effect of throwing the area of low pressure to a position slightly to the northward of that which it had occupied on the previous day. (See Fig. 13.)

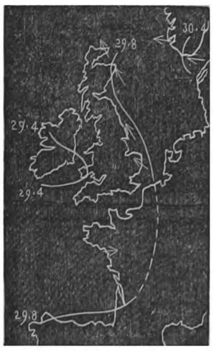

Fig. 13. Feb. 8.

The advance of the general depression to the east had produced a bend in the isobars, which now ran south-eastwards over the North Sea. The gradient from Oxö to Pembroke is nearly 10. The gale still holds with great force from S.E. at Wick and Scarborough. A gale from E. is also reported from Norway, while at L'Orient the force of 8 is registered from W. At Valencia the wind is north-westerly, so that the circulation round the central area is preserved.

A strong easterly breeze commenced to blow at Holyhead at noon, and shortly after increased to a slight gale, but moderated at nightfall, recommencing, however, at midnight and lasting for 15 hours. Heavy snow set in in the north of England in the afternoon of the 8th. During the day a steady rise of the barometer is recorded at all the observatories, while a fall has begun in Norway, so that by the morning of the 9th the area of low pressure in Ireland has entirely disappeared, and the isobars run nearly due W.N.W. and E.S.E. The lowest readings are in the south of France, where an easterly gale is reported from the Golfe du Lion and from Florence. The only strong wind blowing in these islands was at Holyhead, where at noon the velocity of 54 miles an hour from E. by North was registered. At Yarmouth and Falmouth the easterly gales began again in the afternoon, but did not attain any very serious force. Sleet or snow, however, were falling very generally.

During the next two days the barometer continued to rise steadily at all our stations, and in the north of Europe generally, and at 8 a.m. on the 11th the reading at Haparanda was 30·88 in., while at the same time a new depression was approaching the Peninsula, and the barometer at Oporto read 29·49. At Corunna the decrease since the previous day was 0·33 in., while the wind was strong from N.E. Temperature fell rapidly in France, as much as 19° at Rochefort, and the easterly winds increased in force. As we see from Plate IX., the wave of high pressure advanced irregularly over these islands, the maximum reading being recorded at Armagh and Glasgow on the morning of the 11th, at Falmouth about 10 hours later, at the other English and the Irish stations before noon on the 12th, and at Aberdeen about midnight on that day.*

During the day the southern depression advanced steadily eastwards, and by 8 a.m. on the 12th was situated over central Spain, while "a hurricane" from N.E. was reported from Corunna, and at L'Orient and Rochefort also the wind rose to a gale from E. Aurora was again reported from Sandwick on the 11th and 12th. In these islands the barometer was very unsteady, and began to give way at the southern stations during the 12th, while temperature fell very low. The minimum for the month occurred between the 11th and 14th at all except the Scotch observatories. The five-day mean at Kew was again nearly 11° too low. The wind at Yarmouth had again increased to a very severe gale from N.E. by E. at 6 p.m on the 11th, and averaged 55 miles an hour from that point for 83 hours. At Holyhead and Falmouth the gale began before noon, but unfortunately its duration is uncertain at both of these stations, for each of the instruments got out of order during its continuance. The average velocity of the wind recorded by Dr. Hoskins, F.R.S., in Guernsey, was 70 miles an hour from N.E. all through the night. Brilliant aurora was reported from Whitby at night.

Feb. 13. Fig. 14 presents us with a very well-marked instance of a Polar gale, sweeping all over central and southern England, and the north and west of France, and extending westwards to Corunna and southwards to Toulon. The "Carl Georg," which was in the channel, and the "Decapolis," which was off Cape Finisterre, felt the full force of this gale. Capt. Almond, in the latter vessel, reports much lightning, and corposants on the yardarms and mastheads. The barometer at Skudesnaes had risen to 30·81, while the lowest isobar on the chart, that of 29·5, ran nearly along the parallel of 44° N. from Corunna to Nice. The absolutely lowest readings were 29·25 at Oporto and Bayonne, the gradient between Holyhead and Brest was 11, but that from Yarmouth to Cape Grisnez was as much as 16; consequently the greatest force of the gale was over the S.E. of England, the velocity reaching 65 miles an hour at 4 p.m. at Yarmouth. Dr. Hoskins, in Guernsey, reports an average velocity exceeding 60 miles an hour for the whole of the 12th and 13th.

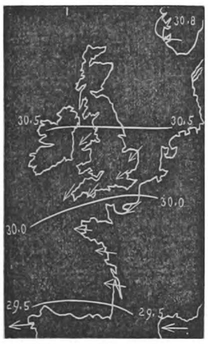

Fig. 14. Feb. 13.

The weather was most inclement, the temperature being very low, and the air filled with dust, and driving snow. It will be remembered that this gale caused serious interference with the telegraphic communications over the United Kingdom. The wind records for the period are very irregular, as will be seen from the Table.

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* These facts show us that Professor Dove is slightly incorrect when he makes the following statement in a recent paper, "Über die Temperaturvertheilung im Winter, 1869–70," in the Monatsberichte of the Academy of Berlin. "It may be considered as an effect of the stoppage of the winds (eine Wirkung des Aufstauens), "that the barometrical maximum appeared on the Lower Rhine between the 10th and 12th, in Brussels on "the evening of the 11th, and in England and Norway on the 13th and 14th."

Observatories, February.	Velocity, 30–40 Miles per Hour.		Velocity, Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Com-menced.	Direction of Wind.	Com-menced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	2 p.m. (12th).	N.E.	4 p.m. (13th).	N.E.	43	4	1 p.m. (14th)	N.E. by E.	47	5 & 6 p.m. (13th).	N.E.	43	—
Armagh -	—	—	—	—	—	—	—	—	—	—	—	—	The N.E. wind freshened considerably at noon on the 13th, and continued strong all next day; however, the velocity only occasionally reached 30 miles.
Glasgow -	—	—	—	—	—	—	—	—	—	—	—	—	The wind freshened from N.E. about noon of 13th, and exceeded 30 miles from 8 p.m. till 7 a.m. (14th), after which it gradually subsided again.
Aberdeen -	5 a.m. (13th).	E.	—	—	—	—	8 p.m. (13th)	E.	15	5 p.m. (13th).	N.E.	38	—
Falmouth -	7 a.m. (11th).	N.E.	9 a.m. (12th).	N.E. by N.	45	23	Uncertain owing to instrument being out of action.			11 a.m. (12th).	N.E. by N.	53	—
Holyhead -	11 a.m. (12th).	E.N.E.	11 a.m. (12th).	E.N.E.	46*	43	3 p.m. (15th)	E.N.E.	?76	11 a.m. & noon (14th).	E.N.E.	60	—
Stonyhurst -	—	—	—	—	—	—	—	—	—	—	—	—	The wind freshened a good deal about 11 a.m. (13th) and continued strong on the 14th, but only reached 30 miles occasionally.
Kew - -	1 a.m. (13th).	N.E. by E.	—	—	—	—	6 p.m. (14th)	N.E. by E.	41	5 p.m. (13th).	N.E.	40	—
Yarmouth -	5 p.m. (10th).	E.N.E.	6 p.m. (11th).	N.E. by E.	55	83	6 p.m. (15th)	N.E.	121	4 p.m. (13th).	N.E. by E.	65	—

* Probably more, but uncertain, as instrument got out of action.

The southern depression advanced eastwards during the day, and by 8 a.m. its centre had reached the neighbourhood of Barcelona, while the wind was blowing very hard from N.E. in the south of France, and a storm from S.E. set in over Italy, accompanied by the unusual phenomenon of red rain, which was observed at Subiaco, near Rome, at Tivoli, Moncalieri, and at other stations. A notice of this occurrence was submitted by M. Harold Tarry to the Paris Academy on June 20, 1870, and published in the "Comptes Rendus." The gale lasted during the greater part of the next day.

It is very remarkable that from the 11th to the 13th, the very days on which the heaviest *easterly* gales were felt over these islands and in France, a very severe *equatorial* gale was raging over the north of Norway, the force of wind reported at Tromsö from 2 p.m. on the 11th until 8 p.m. on the 13th being 10, Beaufort scale, and the direction S.E., veering to S. At Vardö the direction was S.W., and the force ranged from 8 to 10. The barometer at the stations during the continuance of these winds averaged from 30·3 to 29·9, so that the gradients which gave rise to them were due to the great excess of pressure over Central Scandinavia and the Baltic, above that recorded in higher latitudes.

Feb. 14. The barometer had fallen in Norway, and, as a recovery had occurred over Southern France, the general disturbance of equilibrium had been much reduced. The north-east gales, however, still lingered in St. George's Channel and at Yarmouth, gradually dying down during the day.

In order to see in how far the remarkable conditions of weather just described had been prevalent over the Atlantic, the logs of the vessels at sea during the period have been examined, and two of the most interesting registers have been reproduced on Plate A.

The first is that of the "Westphalia," Capt. Trautmann, belonging to the North German Lloyd's line, which has been lent by Herr von Freeden. The other is that of the Cunard steamer "Palmyra," Capt. W. Watson, whose observations have been frequently quoted in these pages. The diagrams are drawn on the same principle as those given in Capt. Toynbee's "Report on the Meteorology of the North Atlantic."

The observations are taken at four-hourly intervals.

The top line of figures represents the force of the wind (Beaufort scale).

The direction (true) of the wind is given by the arrows, which fly with the wind.

The dark full line is for the barometer.

The faint full line is for the sea surface temperature.

The faint line with French dotting is for the air temperature.

To this Capt. Watson adds the curve of the wet-bulb thermometer.

The dotted line is the ship's course.

The course and the time run from right to left in the case of the "Westphalia," from left to right in that of the "Palmyra."

It must be continually kept in mind that these curves differ materially from those which would be obtained from land stations, owing to the fact that the proper motion of the ship must be taken into consideration. The "Westphalia" left the channel on the 29th of January, with a fresh S.E. wind and a falling barometer, the wind veering to South and freshening. The lowest reading was registered at 8 p.m. on the 30th, with a westerly gale, after which the barometer rose briskly, and the wind drew to N.W. and moderated. This was evidently the gale which affected these islands on the 30th and 31st, page 8.

On the afternoon of the 31st the barometer began to go down again, the wind having backed to S.W. and then increased to a heavy gale from W., with severe squalls, continuous rain, thunder and lighting, which lasted until past midnight on the 1st, when the wind again veered to N.W. and moderated at noon next day. This storm apparently corresponds to the slight depression shown on Fig. 9 for Feb. 4, p. 9.

The improvement of the weather was of short duration, for the barometer immediately fell again, the wind backing to S.W. and blowing a heavy gale from W. till noon on the 4th, with a rising barometer.

By this time the "Westphalia" had reached the meridian of 34° W., and it is very remarkable that in this series of observations it is not until 4 p.m. that we can see a trace of the extraordinary depression of the barometer noticed on the evening of the 5th in 25° W. (p. 10). The barometer on board the "Westphalia" fell rapidly from that hour, and reached the level of 28·95, with a strong northerly gale at 4 a.m. on that day, so that it would appear that this area of disturbance in long. 36° W. is probably the same as that whose centre was eleven degrees to the eastward in 25° W. at 6 o'clock in the evening. It is of course impossible to speak positively on such a subject from so limited information.

The only other points specially noticeable in this log are the remarkably sudden oscillations of the barometer in the course of the 7th and 8th. From the direction in which the wind shifted on the evening of the 7th, it is obvious that the ship was on the northern side of the path of the centre of the storm, and we shall see from the log of the "Palmyra" that the disturbance was very local. It was encountered in the region where the cold arctic current is first met with, a district nearly always characterised by storms.

During the 8th the barometer rose quickly till 4 p.m., and then fell for another westerly gale, subsequent to which Capt. Trautmann reports moderate weather till he reached New York on the 12th.

The log of the "Palmyra" which was homeward bound, and passed the "Westphalia" near the banks of Newfoundland on the night of the 7th, shows, as might be expected, much fewer changes of weather than were reported by the outward-bound steamer. The probable reason of this is that suggested by Capt. Toynbee in the report above quoted, viz., that on the outward voyage the observer *meets* the areas of disturbance which are advancing eastwards, while on the homeward passage *he runs with them.*

Capt. Watson left New York on the 3rd of February, and had a much calmer passage than the "Westphalia" had, as the wind hardly ever reached force 8.

The wind was easterly for the first three days, while running along the American coast, with a barometer which was at first high, but fell steadily from midnight on the 4th to noon on the 7th. Subsequently the "Palmyra" had two days of N.W. winds and blue sky. During this period she passed the "Westphalia," but was apparently about 100 miles to the south of her, so that her log does not show a trace of the northerly gale and snow storm recorded by Capt. Trautmann on the night of the 7th, excepting that the N.W. wind increased to the force of 8 about midnight.

On the 10th she ran through another slight area of depression in about 40° W., subsequent to which the wind gradually backed, with mist and fog, from S.W. through S.E. to E. and N.E., and continued from that quarter for the remainder of the voyage.

It will be seen from the plate that the "Westphalia" only experienced 12 hours of easterly winds during the entire passage, so that the easterly gales felt in these islands during the second week of February were not prevalent to any extent over the Atlantic at the beginning of the month; in fact we have already seen (p. 11) that these gales were caused by the efflux of cold air from northern Europe.

The "Palmyra" first met these easterly winds in about 30° W. on the 11th, and from that until the 17th experienced very much the same weather as prevailed over the United Kingdom at the time.

These logs, with as many others as could be collected, are in process of discussion by Capt. Toynbee with the view of elucidating the weather over the North Atlantic during the first week of February.

To this lengthened period of disturbance succeeded one of comparative calm: light easterly winds, with dry weather and a low temperature, being generally prevalent, while the barometer was falling gradually at all the stations. Pressure was oscillating over the north of Scandinavia, and on the 18th a considerable decrease is noticeable in the south of Norway, affecting also our own northern stations. On the 19th the winds over these islands backed into North, and next day, as we see from Plate XI., a great unsteadiness of pressure manifested itself at all the observatories, and the barometer in the north fell briskly, to the extent of 0·64 in. at Christiansund, with a heavy W.S.W. gale, which was also felt at our northern stations. It blew hard at Sandwick, commencing from W. by S. on the evening of the 19th, veering to N.W. at 10 next morning, when it increased to a stiff gale, and lasted for 37 hours, with an average velocity of 48 miles an hour. The gale extended down the coast as far as Holyhead and Scarborough, causing a serious reduction of temperature, with snow and hail showers. Aurora was reported from Stockholm on the night of the 19th.

The depression shown at all the observatories, except Valencia, on the 21st passed on to Hamburg, but without causing any serious wind at that station; however, at 8 a.m. on the day in question we find, from the "Bulletin International," that a serious disturbance existed over the Baltic, the lowest reading, 28·55, being at Stockholm at 8 a.m. Heavy southerly gales were reported from the Baltic provinces of Russia, from Riga and St. Petersburg. A difference of 1·7 in. existed between the readings at Stockholm and those in the west of France.

In these islands, after a temporary recovery on the 22nd, the mercury began to fall again, and on the morning of the 23rd, a depression is noticeable at the Scotch observatories which had no appreciable effect on our winds, but increased in magnitude as it crossed the North Sea, and caused a stiff though short S.W. gale at Hamburg on the evening of the 23rd, with a fresh N.E. wind at Skudesnaes. An aurora was again reported at some of our stations in Scotland and Ireland on the same evening.

Meanwhile at our stations pressure continued to give way, and the absolute minimum passed over all the observatories on the 24th, the centre of depression apparently crossing the north of England, for the lowest reading was registered at Stonyhurst, and the oscillation was much more marked at Armagh, Glasgow, and that station than elsewhere. Like its predecessor this disturbance caused no material increase of wind here, but the force had risen to a moderate gale by the time it reached Hamburg.

On the 25th and 26th the barometer continued uniformly low, however, on the morning of the 27th a rapid rise is reported in Norway, extending to the stations on our own east coast, while at the same time a brisk fall is in progress at Valencia. Accordingly a S.E. gale speedily commenced at Valencia and Holyhead, and one from E.N.E. at Sandwick. These strong winds did not last long, and the disturbance passed off in a northerly direction.

The irregularities of temperature on the morning of the 26th were very serious. The reading at Thurso was 25° lower than at Penzance, which again was 11° lower than that at Biarritz.

It is remarkable that as on the 11th and 12th, although the wind at Sandwick and Skudesnaes continued to blow from the eastward all day long, a severe S.W. squall of some hours duration passed over Christiansund this evening, but was not felt elsewhere.

At our own stations the barometrical readings were rather remarkable, as we see from Plate XII. The depression at Valencia was twofold, and as the mercury rose the force of the wind moderated considerably and then increased again, as is shown in the subjoined table.

Observatories.	Velocity, 30–40 Miles per Hour.		Velocity, Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia	9 a.m. (27th).	S.E.	Noon (27th).	S.E.	43	7	9 p.m. (28th)	S.E. by S.	36	7 p.m. (28th).	S.S.E.	54	—
			1 a.m. (28th).	S. by E.	45	10							
Glasgow	8 a.m. (28th).	S.S.E.	—	—	—	—	5 p.m. (28th)	S. by E.	9	4 p.m. (28th).	S.	35	—
Sandwick	9 a.m. (27th).	N.E. by E.	4 p.m. (27th).	E.N.E.	47	12	4 a.m. (28th)	E. by N.	19	Midnight (27th).	E. by N.	49	—
Holyhead	10 a.m. (27th).	S.S.E.	6 p.m. (27th).	S.S.E.	46	15	4 p.m. (March 1st)	S. by E.	54	1 a.m. (Mar. 1st)	S.S.E.	68	—
			2 p.m. (28th).	S.	50	15							
Falmouth	4 p.m. (28th).	S.S.E.	9 p.m. (28th).	S. by E.	45	6	4 a.m. (March 1st)	S.W. by W.	12	11 a.m. (28th).	S. by E.	51	—

The barometer recovered again during the afternoon of the 28th, but at night another depression of short duration passed over every station, causing a sudden violent southerly squall at each observatory except Aberdeen. The rapid fall of the thermometer, when the barometer began to rise and the wind shifted to north-west, is especially worth notice.

At 8 a.m. on the 1st of March barometrical readings in the north of Scotland were below 29 inches. A recovery then set in which was particularly rapid at the Scotch stations, while the depression passed on to Norway, where it caused a heavy S.W. gale at Christiansund and Bodö in the course of the next day.

Meanwhile a fresh disturbance was approaching our southern coasts, and at midnight on the 1st Captain E. W. Capper in the "Palm Tree" in long. 14° W. and lat. 48° 36′ reports a N.E. wind of force 9 with heavy rain, his barometrical reading being as low as 29·25. The gale only lasted for five hours, his barometer still falling. At 5 a.m. the wind fell calm and then veered to S., backing again to E. and N.E. and increasing to a gale from N.E. at 4 p.m. on the 2nd, with the barometer at 29·03.

March 2. In these islands the barometer was very unsteady at the western stations and at Glasgow, while the wind had backed through N. to N.E. at Valencia, and at 9 a.m. increased to a strong breeze which lasted for 31 hours, reaching the force of a gale at 7 a.m. on the 3rd, and maintaining it for eight hours.

At Holyhead the wind rose to a velocity of 30 miles an hour from N.E. at noon, and increased to a gale at 8 p.m. which lasted for 29 hours.

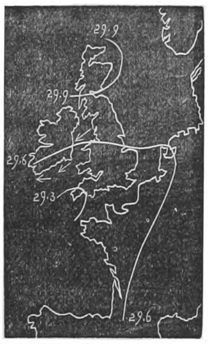

Fig. 15. March 3.

March 3. Fig. 15 shows us an area of low readings close to Penzance, while the district of highest pressure is over Scotland, the gradient from Greencastle to Penzance amounting to 10. Consequently the N.E. gale is felt along St. George's Channel and the south coast of Ireland, as well as at the ships "Palm Tree" and "Lady of the Lake," Captain F. W. Banner, which were distant about 200 miles from Cape Clear in a south-westerly direction. At the same time a heavy westerly storm was blowing at Christiansund.

We see from Plate XIII. that the barometrical oscillation was most serious at Falmouth, becoming much reduced in magnitude before it reached Kew. The gale gradually advanced to the eastward, and it reached Scarborough at 2 p.m., and Yarmouth, where it lasted for 34 hours, at midnight.

Aurora was seen at the northern stations on the nights of the 2nd and 4th.

The barometer rose briskly at all stations during the 4th and 5th, and the wind drew to east generally, freshening to a stiff breeze at Falmouth on the morning of the 5th. Its force, however, moderated at Yarmouth and Holyhead on the evening of that day. The sky meanwhile had cleared in the north-east, but snow fell on our south-east coast.

March 6. The barometer was highest on the west coast of Scotland, and the wind, which was moderate in force, swept round the central area in an anticyclonic course, being westerly in the north, northerly on our east coast, north-east in the Channel, and easterly in the south of Ireland. The weather was dry but cloudy in the south, but it was nearly clear in the north-west, as is also shown by the extent of the daily range in the thermograms from Armagh and Glasgow, Plate XIV. This state of things remained unchanged until the 10th, when the barograms in the north exhibit a brisk reduction of pressure.

All this time barometrical readings over Finland had been low, ranging about 29 inches, and the wind had been strong from the northward over Finmark in Norway on the 8th.

On the nights of the 8th and 9th aurora was again reported from our northern stations, and at noon on the 10th the wind freshened to a stiff westerly breeze at Sandwick and Glasgow, while the barometer fell briskly in Norway, still reading lowest near Torneå. At night a smart N.W. gale began at Sandwick and lasted for eight hours, when it moderated slightly, but continued to blow freshly all day long. Capt. D. Gray, in the "Eclipse," reports a N.W. gale at Lerwick throughout the day.

At night the gale recommenced at Sandwick and reached Holyhead, and by next morning it began at Aberdeen, causing a general fall of snow in the north of Scotland. The following are the particulars at the three stations named.

Observatories.	Velocity, 30-40 Miles per Hour.		Velocity Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Com-menced.	Direction of Wind.	Com-menced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Aberdeen -	6 a.m. (12th).	N.W.	7 a.m. (12th).	W.N.W.	47	11	8 p.m. (12th)	N.W. by W.	14	11 a.m. (12th).	N.W. by W.	50	The N.W. winds were squally all day on the 10th and 11th, frequently exceeding 30 miles per hour. ——
Sandwick -	Noon (10th).	W.N.W.	10 p.m. (10th). 10 p.m. (11th).	N.W. by N. N.W. by W.	43 49	8 16	4 p.m. (12th)	N.W. by N.	52	10 a.m. (12th).	N.W. by N.	66	
Holyhead -	8 p.m. (11th).	N.W. by N.	1 a.m. (12th).	N.W. by N.	42	5	Noon (12th)	N.W.	16	2 a.m. (12th).	N.W.	43	The velocity twice reached 40 miles per hour, in squalls, on the morning of the 11th, and exceeded 30 miles nearly all day.

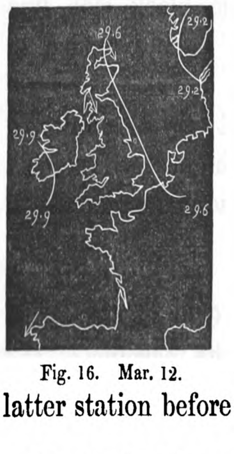

Fig. 16. Mar. 12.

March 12. Fig. 16 shows us that the lowest reading is at Oxö, and the gradient to that station from Greencastle is 8. Accordingly a stiff northerly gale with snow is blowing in the north, reaching the velocity of 66 miles an hour at 10 a.m. at Sandwick, while it has moderated in the Shetlands. It was felt at Alnwick Castle* as a strong breeze from W.N.W. about mid-day. It is remarkable that this gale never reached Hamburg at all.

Weather was calm on the 13th, but next morning the barometer began to fall in the west, and the wind veered to south at Valencia and freshened to a strong breeze, extending to Penzance and Holyhead in the afternoon, reaching the force of a gale at the latter station before midnight, and maintaining it for 25 hours.

March 15. The area of lowest readings on the chart lay near Greencastle, where the mercury at 3 p.m. stood at 29·46, but at the same time the S.S. "Peruvian,"

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* The records of the anemograph, erected at Alnwick Castle, have been forwarded to the office by the kindness of the Duke of Northumberland since the 10th of this month.

Capt. W. H. Smith, in 17° W., and almost on the parallel of Greencastle, reports the barometer at 28·94, rising slowly during the afternoon and night, with light southerly winds. The depression passed over these islands during the 15th and 16th (see Plate XV.), and as it was of extensive area it caused no gale except at Holyhead, but it brought heavy rain with it. On the morning of the 17th the wind was light from the westward over these islands and France.

There is nothing worthy of note until the 20th, when an area of low pressure passed over the north of Norway, causing slight S.W. gales at most of the stations on that coast. It is interesting that on the 20th and 21st, Capt. D. Gray in the "Eclipse," and his brother Capt. J. Gray in the "Mazinthien," not far from the island of Jan Mayen, in lat. 70°–71° N., and on the meridian of Greenwich, were on the western side of this depression and had a stiff N.W. gale, during which the "Eclipse" had to heave to under a stream of ice. Our winds were very light during the time, as Plate XVI. shows.

On the night of the 21st the barometer began to fall very rapidly in the south of Norway, and the decrease at Christiansund at 8 a.m. next morning had amounted to 0·89 inches in the 24 hours. A northerly gale set in at Sandwick at 9 p.m. on the 21st, lasting for 31 hours. During the night a barometrical depression seems to have propagated itself *south-westwards* over Scotland, Plates XVI. and XVII., the minimum being registered at Aberdeen at 11 p.m., at Glasgow at 4 a.m., at Armagh at 6.30 a.m., and at Stonyhurst at 9 a.m. At Kew the lowest reading occurred at 2.30 p.m.

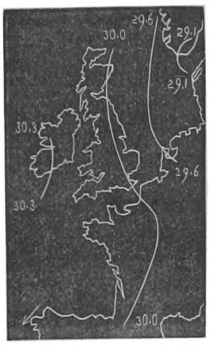

Fig. 17. March 23.

The sudden depression of temperature which occurred at the moment the wind shifted to east is very remarkable at Armagh, Stonyhurst, and Kew, and to a less extent at Falmouth; at the other stations it was much more gradual; at Aberdeen the phenomenon is not shown, owing to the fact of its occurring at midnight, so that the curve is merged in the black side line of the plate. In the evening the northerly gale extended to Holyhead, and lasted through the night.

March 23. The conditions on Fig. 17 are not very dissimilar to those on Fig. 16 for the 12th; the barometer is highest at Valencia and lowest at Oxö, and the difference of readings amounts to 1·24 inches, but there is no actual gale reported.

March 24. The rise of the barometer at Oxö has amounted to 0·75, while at the same time a decrease has set in in the south and west, so that by the morning of the 25th light easterly winds were generally prevalent. The depression was most marked at Falmouth, and it passed eastwards during the day, causing the winds at the English stations to back to N.N.E. and N., but without any material increase of force.

From this to the end of the month there was nothing of any consequence to report; winds were very light, and the weather dry, but cloudy.

Aurora was reported at several stations on the 23rd, and between that day to the 31st it was observed on six nights at Sandwick, some of the displays being very brilliant.

Remarks.

Wind.—The following table shows the number of hours during which the wind reached the velocity of 30 miles or upwards per hour, irrespective of its direction, during the entire quarter:—

Observatory.	Jan.	Feb.	Mar.	Total.	Observatory.	Jan.	Feb.	Mar.	Total.
Valencia - -	182	140	99	421	Falmouth - -	133	141*	59	333
Armagh - -	31	32	4	67	Holyhead - -	226	247†	195	668
Glasgow - -	10	53	19	82	Stonyhurst -	16	31	13	60
Aberdeen - -	34	105	67	206	Kew - - -	19	46	6	71
Sandwick - -	126	194	146	466	Yarmouth - -	90	230	74	394

* Between Feb. 13th and Feb. 16th the instrument was stopped for 72 hours for repairs. A N.E. gale was blowing for a great part of this time.

† From 9 a.m. 13th, to 10 a.m. 14th the instrument was out of order; a N.E. gale was apparently blowing all the time.

If this table be compared with that for the first quarter of 1869, which will be found at page 31 of Vol. I., it will be observed that the amount of high wind registered at Valencia was about half as great in 1870 as in the preceding year. The list is, as usual, headed by Holyhead, and Yarmouth also shows a high figure, owing to the persistence of the easterly gale in February. Stonyhurst recorded less than a tenth of the amount registered at Holyhead, the nearest station to it.

Pressure.—Appendix I. gives the monthly means as well as the extreme readings for all the observatories in Table I. These readings are reduced to 32°, but not to sea level. Applying this latter correction we get the following tabular statement:—

January.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	Inches.	Inches.	Inches.	D. H.	Inches.	D. H.	Inches.
Valencia - -	29·878	+0·124	30·569	23rd, 11 a.m.	28·516	8th, 1 a.m.	2·053
Armagh - -	29·881	+0·106	30·633	19th, 9 p.m.	28·494	8th, 5 a.m.	2·139
Glasgow - -	29·919	+0·183	30·691	19th, 9 p.m.	28·586	8th, 10 a.m.	2·105
Aberdeen - -	29·850	+0·137	30·731	19th, 11 a.m.	28·586	8th, Noon	2·145
Falmouth - -	30·005	+0·033	30·585	18th, 11 a.m.	29·171	8th, 6 a.m.	1·414
Stonyhurst - -	29·944	+0·131	30·662	19th, 11 a.m.	28·622	8th, 9 a.m.	2·040
Kew - - -	30·029	+0·091	30·663	18th, 11 a.m.	29·081	8th, Noon	1·582

The means quoted as "average" are, for Valencia, the figures in App. II., calculated from five years observations at 8 a.m. Greenwich time, and *uncorrected* for daily range.

That for Stonyhurst is the mean published by the College, but reduced to sea level.

Those for the other stations are taken from Mr. Buchan's paper in the Journal of the Scottish Meteorological Society, vol. ii., new series, p. 251. The mean for Helston is taken for comparison with Falmouth, and that for Greenwich for comparison with Kew.

Pressure was on the whole above the average, but only very slightly so in the south of England.

The highest reading in the month was 30·731 at Aberdeen, and the lowest 28·494 at Armagh. The maximum range was observed at Aberdeen, and at all the observatories except those in the south of England the range exceeded 2 inches.

February.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	Inches.	Inches.	Inches.	D. H.	Inches.	D. H.	Inches.
Valencia - -	29·762	−0·133	30·508	12th, 8 a.m.	28·750	27th, 8 p.m.	1·758
Armagh - -	29·819	−0·038	30·595	11th, noon	28·926*	27th, midt.	1·669
Glasgow - -	29·853	+0·010	30·647	11th, 10 a.m.	29·025*	28th, 6 a.m.	1·622
Aberdeen - -	29·871	+0·016	30·709	12th, midt.	29·091*	28th, 9 a.m.	1·618
Falmouth - -	29·816	−0·220	30·361	11th, 8 p.m.	29·253	28th, 1 a.m.	1·108
Stonyhurst - -	29·859	−0·044	30·572	12th, 11 a.m.	29·221	28th, 4 a.m.	1·351
Kew - - -	29·880	−0·128	30·396	12th, 10 a.m.	29·393	24th, 3 p.m.	1·003

* These values differ from those given in Table I., which do not fall in Feb. (Civil Time).

February shows a deficiency of pressure except in Scotland.

The highest barometrical reading is again reported from Aberdeen, and the lowest from Valencia, where also the maximum range was recorded.

March.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	Inches.	Inches.	Inches.	D. H.	Inches.	D. H.	Inches.
Valencia - -	30·103	+0·229	30·489	6th, 11 p.m.	29·107*	1st, 1 a.m.	1·382
Armagh - -	30·121	+0·350	30·599	6th, 11 a.m.	28·887*	1st, 3 a.m.	1·712
Glasgow - -	30·092	+0·376	30·602	6th, 8 a.m.	28·933*	1st, 5 a.m.	1·669
Aberdeen - -	30·060	+0·322	30·576	5th, 11 p.m.	28·986*	1st, 7 a.m.	1·590
Falmouth - -	30·072	+0·183	30·501	20th, 10 a.m.	29·241	3rd, 4 a.m.	1·260
Stonyhurst -	30·121	+0·277	30·529	6th, 9 a.m.	29·232*	1st, 4 a.m.	1·297
Kew - -	30·072	+0·242	30·500	20th, 1 am. 28th, 1 p.m.	29·496	3rd, 5 a.m.	1·004

* These values differ from those given in Table I., which is compiled for astronomical time.

In this month readings were much above the average, to the extent of nearly 0·4 in. at Glasgow.

The highest reading was recorded at that observatory, and the lowest, as well as the maximum range, at Armagh.

It will be noticed that, except at Falmouth and Kew, the minimum readings for both February and March occurred during the passage of one and the same atmospherical disturbance which gave rise to a double depression of the barometer at most of the stations.

Temperature.—The means used for the "averages" in the subjoined tables have been derived from various sources.

Those for London, Aberdeen, and Glasgow are from Dove's Klimatologische Beiträge, Part II., p. 140.

Those for Valencia and Armagh are from Mr. Buchan's paper "On the Temperature of the British Islands" (Journal of the Scottish Meteorological Society, vol. iii., p. 102).

That for Stonyhurst is the mean for 22 years published by the College.

No mean has as yet been published which would serve for comparison with Falmouth, as the only stations reasonably near to that town at which good meteorological observations are taken are Truro and Helston, and the local conditions at each of these towns are somewhat different from those which exist at Falmouth.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	°	°	°	D. H.	°	D. H.	°
Valencia - -	44·3	+1·3	53·2	16th, noon	31·3	21st, 11 p.m.	21·9
Armagh - -	39·0	−0·6	51·1	16th, 3 p.m.	23·7	25th, 3 a.m.	27·4
Glasgow - -	36·9	−0·4	44·7	7th, 2 p.m.	26·0	27th, 5 a.m.	18·7
Aberdeen - -	37·1	+1·0	43·7	4th, 1 p.m. 18th, 2 p.m.	24·6	27th, 3 a.m.	19·1
Falmouth - -	43·4	—	54·4	16th, 1 p.m.	30·3	23rd, 9 a.m.	24·1
Stonyhurst - -	37·5	+0·1	48·3*	8th, 1 a.m.	22·3	27th, 5 a.m.	26·0
Kew - - -	39·7	+3·5	51·6	8th, 3 a.m.	24·0	30th, 6 a.m.	27·6

* Two days of omission in January leave the maximum temperature doubtful.

The mean temperature of the month is very nearly at its average amount.

The maximum reading was recorded at Falmouth, and the minimum at Stonyhurst. The greatest range was reported at Kew.

All the minimum readings, except that at Valencia, were recorded during the cold period, which occurred during the last week of the month.

February.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	°	°	°	D. H.	°	D. H.	°
Valencia - -	41·7	−2·4	52·3	6th, 7 a.m.	30·3	13th, 10 p.m.	22·0
Armagh - -	38·3	−2·4	50·9	6th, 4 p.m.	26·5	13th, 8 a.m.	24·4
Glasgow - -	36·4	−1·7	49·0	29th, 6 a.m.	16·0	25th, 2 a.m.	33·0
Aberdeen - -	35·7	−1·5	47·2	29th, 11 a.m.	22·9	23rd, midt.	24·3
Falmouth - -	40·5	—	51·1	26th, 1 p.m.	25·0	11th, 4 a.m.	26·1
Stonyhurst - -	36·7	−1·8	51·4	28th, 3 p.m.	22·5	12th, midt.	28·9
Kew - - -	37·0	−1·3	53·2	28th, 1 p.m.	21·4	12th, 7 a.m.	31·8

The month was accordingly a cold one, especially in Ireland. This result is of course attributable to the unusual prevalence of cold polar winds during the first fortnight. The temperature at all the observatories was from 7° to 8° lower than it had been in February 1869. The maximum reading was registered at Kew, and it was below the absolute maximum registered in January, which was 54°·4 at Falmouth, as we have just seen. The minimum, which was as low as 16°, was observed at Glasgow when the wind was light from the northward. This depression of temperature was strictly local. The extreme range was registered at Glasgow also.

March.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	°	°	°	D. H.	°	D. H.	°
Valencia - -	45·6	+0·2	57·6	18th, 2 p.m.	34·4	5th, 5 a.m. 23rd, 4 a.m.	23·2
Armagh - -	42·0	+0·4	58·6	19th, 2 p.m.	25·2	13th, 6 a.m.	33·4
Glasgow - -	39·7	+0·1	55·5	31st, 2 p.m.	24·3	14th, 7 a.m.	31·2
Aberdeen - -	39·1	+0·3	55·3	19th, 4 p.m.	22·3	12th, 5 a.m.	33·0
Falmouth - -	43·2	—	56·0	18th, 1 p.m.	33·0	27th, 6 a.m.	23·0
Stonyhurst - -	39·5	−0·1	52·4	19th, 1 p.m. 31st, 4 p.m.	26.2*	28th, 6 a.m.	26·2
Kew - - -	40·2	−0·8	59·0	2nd, 2 p.m.	22·6	14th, 6 a.m.	36·4

* Two days of omission in March leave the minimum doubtful.

In March temperature was nearly at its normal value, the difference not amounting to a degree at any station.

The maximum reading was again recorded at Kew, and the minimum at Aberdeen. The greatest range was noticed at Kew.

The following comparison of the five-day means for Kew, with those for 43 years for Greenwich, given by Dove in Part II. of his work, are given as before:—

Dates.	Variation.	Dates.	Variation.	Dates.	Variation.
	°		°		°
Jan. 1–5 -	+ 9·6	Jan. 31–Feb. 4	+ 2·6	Mar. 2– 6 -	+ 0·7
„ 6–10 -	+ 4·6	Feb. 5–9 -	− 0·7	„ 7–11 -	+ 0·9
„ 11–15 -	+ 5·6	„ 10–14 -	−10·7	„ 12–16 -	− 2·2
„ 16–20 -	+ 1·3	„ 15–19 -	− 4·9	„ 17–21 -	+ 3·1
„ 21–25 -	− 7·4	„ 20–24 -	− 2·7	„ 22–26 -	− 5·6
„ 26–30 -	−11·8	„ 25 to Mar. 1	+ 7·3	„ 27–31 -	− 6·5

From this we see that the oscillations of temperature were very rapid; thus, while the temperature from the 26th to the 30th of January was nearly 12° below the average, that of the next five days was 2°·6 above its average, and the next period but one was again 10°·7 below the mean. The first 10 days of March enjoyed their average temperature, but at the end of the month again a cold interval made its appearance.

It must however be remembered that all comparisons of thermometrical observations made at different stations, with instruments of different pattern, and under different conditions of exposure, must be admitted to be more or less unsatisfactory. It is not until we shall have determined the mean temperature of each station by means of a sufficient series of observations made under precisely similar conditions, that we shall be in a position to state in how far the observed temperature of any period differs from its normal amount.

PART 2.

April 1. The weather for the first week in April continued fine and dry with very light winds. Fog was reported from several of our south-western stations. Aurora was observed on the 1st at Cork, and on the 2nd at Sandwick. The "Eclipse," Capt. D. Gray, which was still in high latitudes, 71°–72° N., felt strong squalls from the northward on the 1st and 2nd, with a barometrical reading as low as 28·72 at noon on the latter day. This may possibly be the same disturbance as that which passed over the north of Norway three days later, causing heavy W.S.W. gales at Bodö on the 5th and 6th.

Plate XIX. shows a considerable daily range in the thermograms, and at Kew the nights were very cold for the season, the temperature falling as low as 26° at 5 a.m. on the 4th.

The barometer having reached a maximum at all the observatories between noon on the 3rd and the same hour on the 4th, began to fall generally. The change was at first more rapid in the north than elsewhere, and the wind freshened to a stiff breeze from W. at Sandwick on the 7th.

April 8. A slight depression is noticeable on the N.W. coast of Scotland, the lowest reading being 29·35 at Thurso. However, at the same hour, Capt. Simpson, in the "Traveller," on the same latitude as Thurso, and about 200 miles to the westward of that place, had the mercury as low as 29·0, after a brilliant aurora on the night of the 7th, and strong S.E. winds.

April 9. Pressure having continued to decrease in the west, we see that at 8 a.m. on this day, Fig. 18, a distinct area of low pressure is shown in the south of Ireland, with a fresh N.W. gale. This disturbance was of no great consequence, the gale only extending to Pembroke; but it brought some rain with it, and the wind on our south coast freshened considerably as the depression travelled eastwards during the day.

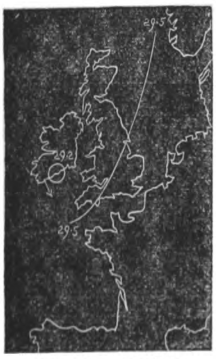

Fig. 18. April 9.

To this succeeded another quiet period with moderate breezes, ranging between south and west, and rain in several places. At Valencia, however, the wind reached the velocity of 30 miles an hour from South at noon on the 11th, and maintained it for 30 hours, the force at times rising to that of a gale. The rainfall at this station exceeded an inch between the 11th and 13th. At Sandwick, too, a strong westerly breeze was recorded from the 14th till late on the 16th. The "Sir Colin Campbell," Capt. A. Murray, in 61° to 63° N. and 11° to 14° W., also felt a gale from S.W. during these days.

April 15. The wind at most of our stations veered to north, while the sky cleared generally and continued so for the next few days, as will also be seen by the extent of the daily range in the thermograms, Plate XXII. Fog was very prevalent in the mornings, and the winds were light, excepting over the Orkney Islands.

April 17. A decrease of pressure appeared over the Bay of Biscay, and on the following day the wind freshened from the eastward in the Channel and on our southern coasts generally, averaging the velocity of 30 miles an hour all day on the 18th at Falmouth, and drawing towards S. in the west of Ireland, where, as well as at Sandwick, a strong S.E. breeze was felt on the 20th. Aurora was reported by Dr. Clouston at the latter station on the nights of the 16th, 18th, and 19th.

April 21. At 8 p.m. on the 20th the "Sir Colin Campbell," which was now in 62°.5′ and 16° W., reports the mercury as low as 29·08, followed by "a complete hurricane from W.S.W., lasting about eight hours." At midnight the barometer at Valencia began to fall slightly, and by 7 a.m. the wind had again backed to S.S.E., and increased to a gale, which only lasted for a few hours. The breeze, however, continued fresh all day, and by 11 a.m. had extended to Holyhead. At night a magnificent aurora was seen at the Irish stations and at Sandwick.

The barometer had recovered slightly at Valencia during the afternoon, but at 9 p.m. a fresh decrease set in, and by 8 a.m. on the 22nd the isobars had assumed the form shown in Fig. 19, the lowest reading being at Greencastle, to which station there was a gradient of 13 from Holyhead. Plate XXIII. proves that the wind had freshened at all the western and northern stations during the 21st, and at midnight the gale began again at Valencia and blew very hard until 7 a.m.

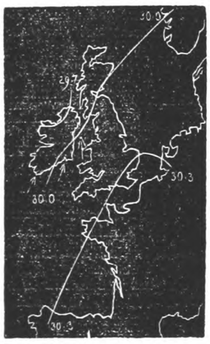

Fig. 19. April 22.

The subjoined table gives the entire records of the disturbance, which, as will be seen, was not felt at Falmouth or on the east coast of England, excepting at Alnwick.

Observatories.	Velocity, 30–40 Miles per Hour.		Velocity Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia	5 a.m. (21st).	S.S.E.	7 a.m. (21st). 1 a.m. (22nd).	S.E. by S. S.E.	44 55	7 6	3 p.m. (22nd)	S.W.	34	6 a.m. (22nd).	S.	65	—
Armagh	6 a.m. (22nd).	S by E.	—	—	—	—	9 a.m. (22nd)	S. by E.	3	9 a.m. (22nd).	S. by E.	38	—
Glasgow	9 a.m. (22nd).	S. by E.	—	—	—	—	3 p.m. (22nd)	S. by W.	6	Noon (22nd).	S.	38	—
Aberdeen	9 a.m. (22nd).	S. by E.	—	—	—	—	11 a.m.(22nd)	S. by E.	2	10 a.m. (22nd).	S. by E.	39	—
Sandwick	8 a.m. (22nd).	S.S.E.	11 a.m. (22nd).	S.E. by S.	45	2	1 p.m. (22nd)	S. by E.	5	Noon (22nd).	S.E. by S.	45	—
Holyhead	11 a.m. (21st).	S.	6 a.m. (22nd)	S.S.E.	48	9	4 p m. (22nd)	S.S.W.	29	1 p.m. (22nd).	S.	53	—
Alnwick Castle	11 a.m. (22nd).	S.	—	—	—	—	4 p.m. (23rd)	S.W.by W.	29	3 p.m. (22nd).	S. by W.	47	This velocity was only reached for one hour.

It is remarkable that at the three Scotch stations the wind rose to the velocity of 30 miles an hour almost simultaneously.

To this disturbance a few days of fine weather, with moderate westerly winds, succeeded.

April 26. Some unsteadiness of pressure is betrayed by the Irish and Scotch barograms, while in the west of Norway the barometer fell rather rapidly. At Sandwick a moderate W.N.W. gale set in and lasted for 24 hours from noon; the hardest force was experienced at midnight from N.W. At Holyhead, too, strong winds from the same quarter were felt during the 26th and 27th, as will be seen from the table.

Observatories.	Velocity, 30–40 Miles per Hour.		Velocity Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Sandwick	5 a.m. (26th).	W.	1 p.m. (26th).	W.N.W.	47	24	2 a.m. (28th)	N.N.W.	46	Mdngt. to 2 a.m. (27th).	N.W.	53	—
Holyhead	8 p.m. (26th).	W.N.W.	1 a.m. (27th).	N.W.	43	6	11 a.m.(27th)	N.W. by W.	15	3 a.m. (27th).	N.W.	47	—
	4 p.m. (27th).	N.N.W.	9 p.m. (27th).	N.W. by N.	42	3	11 a.m.(28th)	N.N.W.	19	9–11 p.m. (27th).	N.N.W.	42	—

April 27. A considerable fall of the barometer had occurred in the south of Norway, so that the gradient from Thurso to Skudesnaes was increased to 12, and the wind was generally north-westerly and fresh on our north-east coasts. During the day the gale extended to the Norwegian stations, where it blew hard during the 28th, while northerly winds were reported over the British Isles.

Plate XXIV. shows us that pressure began to decrease at all our observatories in the course of the 28th. The change was most rapid at first in the north, so that the wind backed to north-west and west, and blew moderately freshly from that direction at the Scotch and Irish stations on the morning of the 30th.

During the day the barometer continued to fall, the change becoming rapid in Norway, and a S.E. gale beginning at Skudesnaes at 2 p.m. From Plate XXV. we see that the Scotch barograms exhibit a recovery soon after midnight, and at 4 a.m. a sudden northerly gale set in at Sandwick, while at Falmouth a stiff breeze from W.N.W. was felt at about the same hour. Most of our northern and western telegraph stations reported a slight N.W. gale during the night.

Observatories.	Velocity, 30-40 Miles per Hour.		Velocity, Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Sandwick -	4 a.m. (1st).	N.	4 a.m. (1st).	N.	47	13	11 p.m. (2nd)	N.W.byN.	43	7 a.m. (1st).	N.	53	—
Glasgow -	10 a.m. (1st).	N.	—	—	—	—	4 p.m. (1st)	N.	6	Noon (1st).	N.	37	—
Holyhead -	2 p.m. (1st).	N.W.	5 p.m. (1st).	N.N.W.	43	3	6 a.m. (2nd)	N.	16	6 p.m. (1st).	N.N.W.	44	—
Falmouth -	6 a.m. (1st).	W.N.W.	—	—	—	—	6 p.m. (1st)	W.N.W.	12	11 a.m. (1st).	W.N.W.	39	—

May 1. Fig. 20 shows us that the centre of depression is near Skudesnaes, and as the gradient from Thurso to that station is not more than 6, the only gale reported at 8 a.m. is that at Sandwick. During the day this extended to Glasgow and Holyhead, but was not of great force. These northerly winds gradually died down, and the barometer rose generally. From the 4th to the 8th the area of maximum pressure lay over Ireland, while the wind swept in an anticyclonic course from N.N.W. in Caithness through N. on our east coast to N.E. in France, being uniformly light in force.

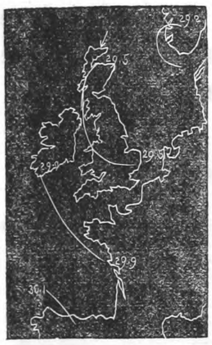

Fig. 20. May 1.

May 8. A general and steady decrease appears in all the barograms, and in the course of the 10th this became serious at the western stations. By 8 a.m. on the 11th the isobars had assumed the shape shown on Fig. 21.

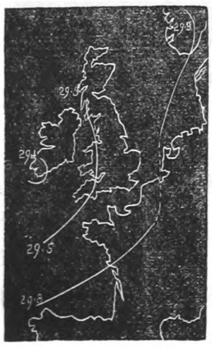

Fig. 21. May 11.

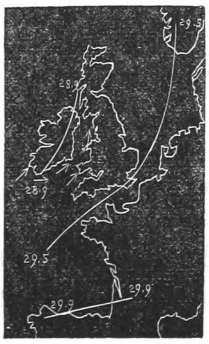

Fig. 22. May 12.

Plate XXVII. shows us that the disturbance was much more marked at the Irish stations than in Great Britain. This fresh depression of the barometer is noticeable at all the observatories; but while at Valencia and Armagh it was succeeded by a second during the early hours of the 12th, no distinct trace of this latter oscillation is observed elsewhere except at Glasgow.

The gale did not begin until 10 a.m. at Holyhead, and at Valencia it was ten hours later in commencing. It blew very hard in the south of Ireland, averaging 70 miles an hour from 2 to 6 a.m. on the 12th at Valencia. Fig. 22 for the 12th exhibits the isobar of 28·9, stretching from Cape Clear to Islay, with a gradient of 12 from Penzance to Valencia, and of 13·5 from Corunna to the latter station. Of course a heavy south-west gale is blowing on the south coast of Ireland, which extended during the day to most of the observatories.

Observatories.	Velocity. 30-40 Miles per Hour.		Velocity. Exceeding 40 Miles per Hour.				Velocity. Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia	8 p.m. (11th).	S.S.W.	8 p.m. (11th).	S.S.W.	52	21	6 p.m. (13th)	W.S.W.	46	2–6 a.m. (12th).	S.S.W.	70	—
			Noon (13th).	S.	46	3							
Armagh	11 a.m. (12th).	S.	—	—	—	—	3 p.m. (12th)	S.S.W.	4	1–3 p.m. (12th).	S.S.W.	36	—
Glasgow	11 a.m. (12th).	S.E. by S.	—	—	—	—	9 p.m. (12th)	S. by E.	10	1–3 p.m. (12th).	S.S.E.	38	—
Sandwick	2 a.m. (12th).	E.	—	—	—	—	2 a.m. (13th)	S.E.	24	1 p.m. (12th).	S.E.	39	—
Falmouth	2 a.m. (12th).	S.W. by S.	11 a.m. (12th).	S.W. by S.	42	6	7 p.m. (12th)	S.W. by S.	17	1 p.m. (12th).	S.W. by S.	47	—
	11 a.m. (13th).	S.W. by W.	—	—	—	—	6 p.m. (13th)	S.W. by S.	7				
Holyhead	9 a.m. (11th).	S.E.	10 a.m. (11th).	S.E.	45	6	2 p.m. (15th)	S.S.W.	101	3 p.m. (12th).	S.	60	—
			10 p.m. (11th).	S. by E.	49	24							
			6 p.m. (13th).	S.	46	4							
Stonyhurst	7 a.m. (12th).	S. by W.	—	—	—	—	2 p.m. (12th)	S.S.W.	7	11 a.m. & 1 p.m. (12th).	S.S.W.	40	This velocity was not exceeded.
Kew	10 a.m. (12th).	S.W.	3 p.m. (12th).	S.W.	41	1	7 p.m. (12th)	S.W.	9	3 p.m. (12th).	S.W.	41	—

It will be seen from this table that the wind at the extreme northern station, Sandwick, was at first easterly and then veered slightly to S.E.

The rainfall on the 11th was very heavy, especially in the south-western districts; more than an inch falling at Pembroke, Plymouth, and Brest.

May 13. The gale haa died down generally, but a slight depression is noticeable in the barogram for Valencia about noon on the 13th, which is also to be perceived in the curves from the northern stations, but does not appear at Falmouth or Kew. It was accompanied by a fresh increase of force in the wind, which extended to the Channel and Holyhead during the day, and was also felt by the "Gosforth," Capt. H. P. Wight, in 47° N. and 16° W.

The weather continued steadily fine in England until the end of the month, and the instrumental records show very slight changes; however, both on the 17th and 19th, moderate southerly gales swept over Ireland and the Irish Channel, and extended across to Alnwick. The latter of these was also felt at Sandwick.

Observatories.	VELOCITY. 30-40 Miles per Hour.		VELOCITY. Exceeding 40 Miles per Hour.				VELOCITY. Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	MAXIMUM VELOCITY.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	8 p.m. (16th).	S.	3 a.m. (17th).	S.	49	23	2 a.m. (18th)	S. by W.	30	3 p.m. (17th).	S.	52	—
Holyhead -	6 a.m. (17th).	S.	11 a.m. (17th).	S.	43	15	9 p.m. (18th)	S. by W.	39	7 p.m. (17th).	S. by W.	47	—
Alnwick Castle	8 a.m. (17th).	S.S.W.	9 p.m. (17th).	S.W. by S.	45	2	3 a.m. (18th)	S.W.	19	10 p.m. (18th).	S.W. by S.	48	—
Valencia -	1 a.m. (19th).	S.S.E.	8 a.m. (19th).	S.S.E.	48	8	9 p.m. (19th)	S.S.W.	21	10 a.m. (19th).	S.E. by S.	51	—
	1 a.m. (20th).	S. by W.	5 a.m. (20th).	S.	45	2	9 p.m. (20th)	S. by W.	21	7 a.m. (20th).	S. by W.	46	—
Sandwick -	6 p.m. (19th).	S.	8 p.m. (19th).	W.S.W.	47	2	3 a.m. (20th)	W.S.W.	10	8-10 p.m. (19th).	W.S.W.	47	—
Holyhead -	2 a.m. (19th).	S.	1 p.m. (19th).	S.	42	4	11 p.m. (20th)	S.S.W.	47	3 p.m. (19th).	S.	45	—
Alnwick Castle	5 a.m. (19th).	S.W. by S.	9 p.m. (19th).	S.W.	51	2	3 a.m. (20th)	S.W. by S.	22	10 p.m. (20th).	S.W. by S.	55	—

Temperature was high during the latter half of the month, and at Kew the unusual temperature (for the month of May) of 81° was registered at 5 p.m. on the 21st.

The barometer reached its maximum for the month at all the observatories in the 24 hours succeeding 11 p.m. on the 24th. Subsequently to this pressure began to decrease, and the rate became more rapid at Valencia on the evening of the 29th, so that by 8 a.m. next morning the distribution of pressure was that represented on Fig. 23, while a moderate southerly gale was reported at Brest and in the south of Ireland.

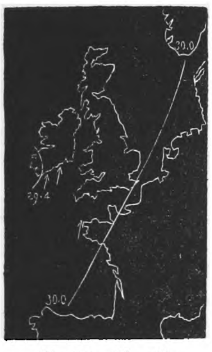

Fig. 23. May 30.

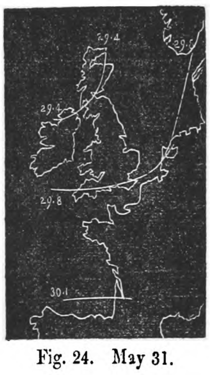

Fig. 24. May 31.

This disturbance was not of serious consequence, and by 8 a.m. on the 31st, Fig. 24, the centre of depression is found on the west coast of Scotland, while the gradients have much decreased and the wind has died down.

June was a month of almost uninterrupted fine weather, being nearly absolutely rainless in the south of England, and very dry elsewhere. Temperature was high, with a considerable daily range, especially during the first ten days.

The barometer rose steadily between the 1st and 6th, on which latter day a clearly marked anticyclone existed, accompanied as usual by very light winds. The centre of highest pressure was over Ireland. A decrease then set in which became rapid in the north by the 8th, and at Sandwick a strong breeze from W. and N.W. was felt during that day and the next. The disturbance then passed on to Norway, where, at Christiansund, the decrease between the 8th and 9th amounted to 0.80 in., and our winds shifted to N.W. and freshened somewhat. This state of things was of short duration, for by the 12th the winds had again backed to W. and were very light, except at Valencia, where the breeze was fresh from S.W. Plate XXXIII.

From this to the end of the month there was nothing of any consequence to report, excepting that on the 16th thunderstorms were very prevalent both in the north of Scotland and in England, and on the same day the temperature at Kew reached its maximum for the year, 86°·3. Hot weather was again experienced, especially on the east coast, from the 19th to the 22nd, when the wind veered generally to N.W., causing a considerable fall in temperature at most of our stations.

Remarks.

Wind.—The following table shows the number of hours during which the wind reached the velocity of 30 miles or upwards per hour, irrespective of its direction, during the entire quarter.

Observatory.	April.	May.	June.	Total.	Observatory.	April.	May.	June.	Total.
Valencia - -	87	175	38	300	Holyhead - -	99	255	43	397
Armagh - -	5	5	0	10	Stonyhurst -	4	10	5	19
Glasgow - -	42	34	5	81	Alnwick Castle -	63	95	23	181
Aberdeen - -	22	10	3	35	Kew - - -	0	12	0	12
Sandwick - -	160	105	52	317	Yarmouth - -	0	10	0	10
Falmouth - -	38	92	28	158					

Holyhead shows the highest number of hours of high wind, but Sandwick and Valencia do not fall very far short of it. Alnwick Castle, too, proves itself to have been well exposed to the wind during the quarter, and in this respect shows a marked contrast not only to Stonyhurst but also to Yarmouth.

*Pressure.**—

April.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	Inches.	Inches.	Inches.	D. H.	Inches.	D. H.	Inches.
Valencia - -	30·137	+0·215	30·524	15th, midgt.	29·088	9th, 2 a.m.	1·436
Armagh - -	30·092	+0·188	30·539	16th, 10 a.m.	29·287	9th, 6 a.m.	1·252
Glasgow - -	30·029	+0·136	30·492	16th, noon	29·282	30th, 8 p.m.	1·210
Aberdeen - -	29·954	+0·038	30·463	3rd, 1 p.m.	29·162	30th, 7 p.m.	1·301
Falmouth - -	30·199	+0·196	30·562	16th, 11 a.m.	29·452	9th, 8 a.m.	1·110
Stonyhurst - -	30·099	+0·207	30·526	16th, 10 a.m.	29·386	30th, midngt.	1·140
Kew - - -	30·158	+0·190	30·562	4th, 8 a.m.	29·486	9th, noon	1·076

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* For an explanation of these tables, see Part I., p. 23.

Pressure was considerably above the average, excepting at Aberdeen.

The highest reading recorded was 30·562, which was registered both at Falmouth and Kew. The lowest was 29·088 at Valencia. The range was very uniform; it was greatest at Valencia and least at Kew.

May.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	Inches.	Inches.	Inches.	D. H.	Inches.	D. H.	Inches.
Valencia - -	29·976	+0·115	30·478	24th, 11 p.m.	28·767	12th, 5 a.m.	1·711
Armagh - -	29·963	+0·041	30·528	25th, 9 a.m.	28·777	12th, 1 p.m.	1·751
Glasgow - -	29·936	+0·027	30·457	25th, 11 p.m.	28·933	12th, 5 p.m.	1·524
Aberdeen - -	29·911	−0·041	30·448	25th, 9 p.m.	29·072	12th, 7 p.m.	1·376
Falmouth - -	30·091	+0·086	30·444	25th, 8 a.m.	29·242	11th, 3 p.m.	1·202
Stonyhurst - -	30·007	+0·099	30·468	25th, midt.	29·149	11th, 5 p.m.	1·319
Kew - - -	30·083	+0·117	30·417	25th, 11 p.m.	29·364	11th, 9 p.m.	1·107

In this month the mean of the barometer was nearly at its ordinary height at all stations.

The range was considerable, owing to the serious depression which took place on the 11th and 12th. The maximum reading was reported at Armagh, and the minimum at Valencia; the greatest range being at the former observatory, and the least at Kew.

June.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	Inches.	Inches.	Inches.	D. H.	Inches.	D. H.	Inches.
Valencia - -	30·204	+0·099	30·598	6th, 10 a.m.	29·853	17th, 6 p.m.	0·745
Armagh - -	30·133	+0·216	30·638	6th, 7 a.m.	29·640	10th, 5 p.m.	0·998
Glasgow - -	30·062	+0·173	30·607	6th, 6 a.m.	29·530	11th, 2 a.m.	1·077
Aberdeen - -	30·021	+0·100	30·623	5th, 10 a.m.	29·425	11th, 9 a.m.	1·198
Falmouth - -	30·207	+0·160	30·565	6th, 9 am.	29·898	17th, 2 a.m.	0·667
Stonyhurst -	30·108	+0·188	30·612	5th, 10 p.m.	29·650	10th, 11 p.m.	0·962
Kew - -	30·134	+0·154	30·572	5th, midt. 6th, 7 a.m.	29·732	10th, 4 p.m.	0·840

Readings were still above the average, but pressure was much less disturbed than it had been in May. The range exceeded an inch only at the Scotch stations, and was greatest at Aberdeen, where the lowest reading 29·425 was recorded. The maximum readings were remarkably uniform, the highest 30·638 being at Armagh, while the others did not differ as much as 0·1 in. from it.

Temperature.—

April.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	°	°	°	D. H.	°	D. H.	°
Valencia - -	49·7	+0·5	61·5	17th, 4 p.m.	37·8	15th, 6 a.m.	23·7
Armagh - -	48·1	+0·8	64·6	17th, 3 p.m.	34·8	18th, 4 a.m.	29·8
Glasgow - -	46·9	+2·0	69·7	18th, 3 p.m.	31·4	3rd, 7 a.m.	38·3
Aberdeen - -	46·4	+3·3	65·4	25th, 3 p.m.	33·7	4th, 5 a.m.	31·7
Falmouth - -	48·0	—	58·2	20th, 5 p.m.	36·5	5th, 6 a.m.	21·7
Stonyhurst - -	47·4	+2·9	71·7	20th, 3 p.m.	32·7	6th, 5 a.m.	39·0
Kew - - -	48·7	+2·9	75·6	20th, 2 p.m.	26·0	4th, 5 a.m.	49·6

The mean temperature of April was somewhat lower than it had been in the previous year, but was still about 3° above the average in Great Britain, and very near the average in Ireland. The range of the thermometer was great at Kew, as on the 4th the temperature had fallen to 26°, an unusual degree of cold for April. At Falmouth the range was very slight.

May.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	°	°	°	D. H.	°	D. H.	°
Valencia - -	52·4	−0·5	65·6	25th, 3 p.m.	40·7	2nd, 6 a.m.	23·9
Armagh - -	51·8	−0·4	71·3	21st, 4 p.m.	37·0	2nd, 5 a.m.	34·3
Glasgow - -	50·9	+0·5	70·9	27th, 4 p.m.	32·5	4th, 5 a.m.	38·4
Aberdeen - -	49·9	+1·7	63·1	18th, 4 p.m.	35·0	3rd, 2 a.m.	28·1
Falmouth - -	52·4	—	66·2	19th, 3 p.m.	38·2	3rd, 3 a.m.	28·0
Stonyhurst - -	51·6	+1·7	71·0	21st, 4 p.m.	31·3	4th, 5 a.m.	39·7
Kew - - -	53·5	+1·0	81·0	21st, 5 p.m.	32·0	8th, 5 a.m.	49·0

The temperature was nearly at its average height during May, and the range was generally moderate, except at Kew, where, during the hot weather which prevailed about the 20th, the thermometer rose 10° higher than at any other station. The lowest temperature was recorded at Stonyhurst, where the mercury fell below the freezing point.

June.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	°	°	°	D. H.	°	D. H.	°
Valencia - -	57·7	+1·0	73·5	7th, 1 p.m.	49·0	17th, 1 a.m.	24·5
Armagh - -	57·6	−0·5	73·6	6th, 2 p.m.	44·6	12th, 5 a.m.	29·0
Glasgow - -	55·5	−0·3	76·0	6th, 4 p.m.	43·6	10th, 2 a.m.	32·4
Aberdeen - -	54·8	−0·2	77·7	21st, 5 p.m.	41·3	12th, 1 a.m.	36·4
Falmouth - -	59·3	—	74·9	22nd, 2 p.m.	47·7	3rd, 4 a.m.	27·2
Stonyhurst - -	56·9	+2·2	74·6	7th, 5 p.m.	45·4	2nd, 4 a.m.	29·2
Kew - - -	61·7	+3·6	86·3	16th, 4 p.m.	43·4	7th, 4 a.m.	42·9

The month was warmer than the average at Kew and Stonyhurst, but elsewhere the temperature was nearly exactly normal. The range was, as usual, greatest at Kew, where the temperature rose as high as 86°·3 on the afternoon of the 16th. The lowest reading 41°·3 was recorded at Aberdeen.

The following is the comparison of the five-day means for Kew with those for Greenwich, which has been drawn out on the same plan as those in the previous numbers.

Dates.	Variation.	Dates.	Variation.	Dates.	Variation.
April 1–5 -	– 4°·2	May 1–5 -	– 6°·2	May 31–June 4	+ 2°·7
„ 6–10 -	+ 1·9	„ 6–10 -	– 6·7	June 5–9 -	+ 1·6
„ 11–15 -	+ 4·8	„ 11–15 -	+ 2·7	„ 10–14 -	+ 3·0
„ 16–20 -	+ 8·3	„ 16–20 -	+ 5·4	„ 15–19 -	+ 7·3
„ 21–25 -	+ 6·3	„ 21–25 -	+ 4·8	„ 20–24 -	+ 5·3
„ 26–30 -	– 2·2	„ 26–30 -	+ 2·7	„ 25–29 -	– 2·5

From this we see that a warm period occurred about the middle of each month of the quarter, the greatest excess being noticed between the 16th and 20th of April. The fortnight from April 26th to May 10th was cold, but to it succeeded six weeks of warm weather.

PART 3.

The month of July opened with barometrical readings which were rather high in the south-west, but lowest in the north and centre of Europe. The isobaric lines ran from N.N.W. to S.S.E. over the British Isles, and readings varied from about 30·3 in. on the coast of Portugal to 29·6 in. in Finland and the north of Sweden. The prevailing winds were consequently north-westerly, and light to moderate in force; temperature was low for the time of year, and the weather cloudy over the British Isles, but clear in France. On the night of the 1st a thunderstorm was recorded at Stonyhurst.

July 2. The barometer continued to fall steadily in northern Europe, but the change was scarcely felt in this country. By 8 a.m. on the 3rd a definite depression of no great importance, whose minimum readings were about 29·1 in., lay over the Gulf of Bothnia. The wind, nevertheless, freshened to a gale from N.N.W. at Skudesnaes, which was felt also by Capt. A. Simpson, of the "Traveller," in the Skager Rack. In our islands the wind was light.

A temporary change in the distribution of pressure now occurred. The barometer began falling rather faster at our north-western stations, and a new but slight depression advanced from the westward towards the Scotch coast (Plate XXXVII.), while that over the Gulf of Bothnia disappeared. The minimum reading was reached at Armagh at 4 a.m. on the 4th, at Glasgow by 5.30 a.m., Stonyhurst by 7 a.m., and Aberdeen at 9 a.m. The barometer remained rather low at our northern stations till the 6th, on which day the wind drew into S.W. generally and freshened to a stiff breeze at the northern stations, with warmer weather and rain, while the "Traveller," which was now in the North Sea, in the latitude of Peterhead, met with a fresh S.W. gale in the afternoon.

The barometer then commenced to rise, and the recovery extended to Norway on the 7th.

The changes in pressure were very slight for a week after this day, and readings remained extremely uniform throughout Europe. On the 7th the sky became clear and the weather warm for a day or two in the south and east of this country. The wind at Valencia freshened to between 30 and 42 miles an hour for a short time, and a strong breeze was reported from Swansea also. July 9th, a slight depression had formed in the north of Russia, but disappeared the next day.

July 14. A slight fall of the barometer at our western stations, accompanied by a rise elsewhere, caused a fresh southerly breeze on our western coasts, which brought some rain with it.

A series of slight barometrical oscillations took place during the next three days over nearly the whole of Europe, accompanied by cloudy weather and rain. Thunderstorms occurred at Aberdeen and London on the night of the 15th, and at Leith on the 16th. The barometer then rose steadily, and readings were again very uniform.

July 20. The sky cleared at all the southern stations, the weather having been until this time *generally* cloudy in the United Kingdom, though less so in the S.E. of England than elsewhere, as may be seen by the large diurnal range of temperature at Kew. The maximum pressure for the month occurred in the S. of England at 8 a.m. On the night of this day and morning of the 21st a decided concavity is noticed in the northern barograms, owing to the existence of a slight depression, the centre of which lay between the Scotch and Norwegian coasts at 8 a.m. on the 21st.

The disturbance had disappeared the next morning (22nd) without producing any material effect on the force of the wind, and had given place to an anticyclone which had formed over the central parts of the United Kingdom; readings remaining remarkably uniform throughout western Europe. The extreme western and the south-western pressures then gave way slowly while the northern and eastern increased, so that by the morning of the 24th the S.W. portion of an enlarged anticyclone lay over Norway and the North Sea, producing moderate easterly breezes on our southern coasts and in France, and light south-easterly winds in the north. The weather during this period was very fine and warm throughout the west of Europe, with a little fog or haze in a few places. The maximum temperature for the month was registered at Kew on the 22nd, at Armagh and Aberdeen on the 23rd, at Valencia and Glasgow on the 24th, and at Falmouth and Stonyhurst on the 25th.

July 25. During the night of the 24th, and early on the 25th, thunder and lightning prevailed in the south of England, previous to which the wind freshened to nearly 30 miles an hour from E. at the entrance of the English Channel, accompanied by a remarkable though slight unsteadiness of pressure at Falmouth, which apparently passed on to Kew before noon on the 25th, while at Stonyhurst more serious oscillations are noticed later in the day (Plates XLI. and XLII.). At 8 a.m. on the 25th a slight disturbance of a cyclonic character, accompanied by cloudy weather, is found over the south-west of England, from the effects of which, however, the barometer at Valencia is already rising. By the 26th the disturbance had travelled eastwards, and lay off the south-east coast of England. Thunderstorms prevailed in the south-east and south of England during the day. The north-westerly and northerly winds on its western side were fresh, exceeding 30 miles per hour for several hours at Falmouth, and rising to 43 miles at Holyhead at 7 p.m.

Another period of fine and very quiet weather ensued, with pressure highest in our N. and N.W. districts, and lowest over the Mediterranean; but cloud was more prevalent, especially over France. The maximum barometrical readings for the month were recorded at the northern observatories on the 28th.

July 29. The north-western pressure began to give way very slowly, and the easterly breeze had freshened over France. The fall of the barometer had become general on the 30th and 31st, cloudy weather was prevalent, and some rain fell over France and the south of England, with thunderstorms at Biarritz and in London.

For the first few days in August pressure was still very uniform, though considerably lower in the neighbourhood of the British Islands than it had been during the latter part of July. It decreased steadily at the Irish and Scotch stations from about midnight of the 2nd till the morning of the 5th, while in the southern and south-eastern districts the change was very slight. Readings thus became rather lower on the western and northern coasts than elsewhere. Temperature continued on the whole somewhat above the average, with light southerly and westerly breezes. The sudden fall of the thermometer at Kew at 1.30 a.m. on the 1st deserves notice. The weather, though clear in some places, was generally cloudy, with a great deal of fog about, and rain in the south of Ireland. Thunderstorms occurred in different parts of the country every day, but the rainfall in them was very small. On the morning of the 2nd, however, a terrific thunderstorm occurred at Mandal (in the south of Norway), when 4·5 inches of rain fell, and more than an inch fell in London in the storm of the 1st.

August 5. A recovery set in at all observatories, with westerly winds and finer weather. On the 6th, however, a slight and temporary fall of the barometer commenced at Valencia, and extended in less degree to most of the other coasts next day. At the extreme northern stations this oscillation was not experienced, the steady rise of the barometer at Aberdeen being only retarded somewhat during the 7th. The wind nevertheless backed to the south-eastward and southward again on our south-west coasts, and freshened. A velocity of 32 miles an hour from S.E. was reached at 9 a.m. on the 6th at Valencia, and 41 miles from the same quarter at Falmouth by 8 p.m. Strong breezes were experienced at Roche's Point and Pembroke also. At 8 a.m. on the 7th there was an almost complete cyclonic circulation of light winds round the lowest pressure. Rain fell at the south-western stations to the depth of an inch at Valencia on the 6th, lightning was seen on the 6th and 7th at Roche's Point, and thunder occurred at Rochefort. Elsewhere the weather was comparatively fine.

The general rise of the barometer was then continued, especially in the west and north. By 8 a.m. on the 9th readings were highest in the N. of Great Britain and lowest over the Mediterranean; but the total difference was only half an inch. Light to moderate easterly winds thus became gradually established over France, England, and Ireland, freshening to 34 miles an hour from N.E. at Yarmouth on the 8th. In Scotland calms and variable airs prevailed. The weather was fine and clear except near London, where it remained showery till the 11th.

The remarkable uniformity of the barograms on Plate XLV. shows the singular steadiness of atmospherical pressure in the United Kingdom from the 9th to the 13th, no change whatever being noticeable, excepting a slight and general increase, not exceeding 0·25 in. in the five days at any observatory. At the same time the regularity and large extent of the diurnal range of temperature indicates the fineness of the weather during the whole period. The maximum temperature for the month was registered at Armagh and Glasgow on the 10th, Stonyhurst on the 12th, and Valencia on the 13th. The wind was generally light to moderate from N. and N.E., except in the western and northern districts; but again blew rather freshly at Yarmouth on the 11th, and at Helder on the 12th and 13th. Capt. T. Moore, of the ship "W. E. Gladstone," also experienced a strong N.N.E. breeze on the 13th, when in lat. 45° 30′ N., long. 11° W. In Ireland and Scotland very variable airs still prevailed, the wind veering one and a half times round the compass at Glasgow between the afternoons of the 10th and 12th, and two and a half times round at Falmouth between 9 a.m. 10th and 3 p.m. 13th.

A steady decrease of pressure now ensued, continuing with great uniformity until the 18th. Its *relative* conditions over western Europe were, however, little altered, except that, between 8 a.m. on the 17th and 18th, a shallow barometrical depression travelled from the westward across the N. of Spain, producing strong easterly breezes over the Bay of Biscay. The wind was otherwise very light and for the most part easterly. Between the 16th and 18th it varied much at Valencia. Cloud became gradually more prevalent. Rain fell locally on our south-east coasts on the 15th, and set in more generally at the Scotch stations after the 16th.

August 18. The fall of the barometer became quicker at the south-eastern stations, and at 8 a.m. of the 19th there was a gradient of rather more than 4 from Greencastle to Brussels. The wind freshened from N. throughout the British Islands and neighbouring countries, with a fall of temperature, and rain on our eastern coasts. This disturbance was, however, very slight, and after the morning of the 19th pressure rose generally, and continued to rise till about midnight on the 21st. Bright aurora was seen at Roche's Point and Campbelton, and by Capt. F. Archer, of the S.S. "Ottawa," in lat. 56° N., long. 14° 30′ W., on the night of the 19th. It was again observed all over Ireland and at Guernsey on the 20th.

In the meantime, however, the general distribution of pressure in other parts of

Europe changed, the relative deficiency over the Mediterranean disappearing between the 19th and 21st.

At 8 a.m. on the 22nd the barometer stood highest over the west of France, while readings in the British Isles were decreasing briskly, as is shown by the sudden dip in the barograms about this time. The minimum pressure was reached at

Armagh -	- at 2 p.m. (on 22nd).
Glasgow -	- „ 3 „ „
Aberdeen Stonyhurst Valencia	- „ 6 „ „
Falmouth -	- „ 8 „ „
Kew -	about 3 a.m. (on 23rd).

The decrease was thus evidently propagated from the north-westward. The wind shifted to S. and S.W. for a short time, on all but the S.E. coasts, and freshened a little; but as the fall of the mercury ceased at the more westerly stations, its direction again veered to W., and ultimately to N.W. Rain fell generally on the 22nd, chiefly in the S.W. of England.

August 23. Pressure was highest over south-western Europe, and apparently lowest in the more northern and central parts, but the difference was yet slight. The winds and weather at Dover, Cape Gris Nez, and Helder, however, seem to indicate the presence of a slight local disturbance between the S.E. of England and the coasts of Belgium and Holland, producing also rather heavy rain in the Channel, with thunder at Cape Gris Nez.

This slight disturbance soon disappeared, and until the 27th the barometer was highest on the western coasts, and apparently lowest on the southern shores of the Baltic. Moderate to fresh northerly winds prevailed throughout western Europe, and temperature was rather low. Lightning and aurora were seen at Thurso on the 25th. Hail fell at Ardrossan, more than an inch of rain at Swansea, and rain was generally reported on our north and east coasts.

August 27. A brisk fall of the barometer commenced in the west and north-west districts, while in the south-east of England there was little change, and over the central part of the continent the barometer seems to have risen slightly. Pressure at 8 a.m. was remarkably uniform, about 29·9 in., in the United Kingdom, but was still lower to the eastward. The fall in the north-west continued, however, and became rapid at Armagh after 2 p.m., and the conditions of pressure at 6 p.m. are shown in Fig. 25, Plate XLVIII. During the ensuing night a small but clearly defined depression crossed the northern parts of England and Ireland, travelling from W.N.W. to

E.S.E., its centre passing between Armagh and Glasgow. The minimum reading was reached at

Armagh - -	at 2 a.m., 28th.
Valencia - -	„ 3 „ „
Glasgow - -	„ 4.30 „ „
Aberdeen -	„ 7 a.m. „
Stonyhurst -	
Falmouth - -	„ 8 „ „
Kew - -	„ noon „

To the northward of its track the wind "*backed*" round from S.E. to N.E. and N., while to the southward it "*veered*," from about S., to W. and N.W. Capt. J. Price in the S.S. "Idaho" (in lat. 51° 14′ N., long. 13° W.) experienced a fresh S.W. gale from 7 p.m. to midnight of the 27th, which subsequently moderated as it shifted to N.W., but at noon of the 28th increased again to a gale from that quarter, when the ship was off Cork Harbour.

At 8 a.m. on the 28th the centre of depression lay off the coast of Lincolnshire (Fig. 26, Plate XLVIII.) and though the cyclonic circulation of wind round it was complete, so far as direction is concerned, the "gradients" were not steep, and the force of a gale was only reached in some parts of the English and Irish channels, more especially in the Straits of Dover. The following table gives the principal features of the anemometrical records during the time.

Observatories.	Velocity, 30-40 Miles per Hour.		Velocity, Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Holyhead -	Noon (28th).	W.N.W.	5 p.m. (28th) 8 p.m. (28th)	N.N.W. N.W.byN.	42·5 44	1 1 } 2	9 p.m. (28th)	N.N.W.	9	8 p.m. (28th).	N.W.byN.	44	Strong squalls from S.S.E. commenced at 4 p.m. (27th) and continued throughout the morning of 28th; gradually veering to N.W., the velocity again exceeded 30 miles, in gusts, from 8 p.m. (29th) to 2 a.m. (30th).
Falmouth -	5 a.m. (28th).	W. by S.	—	—	—	—	6 p.m. (28th)	W. by N.	13	4 p.m. (28th)	W. by N.	38	—
Yarmouth -	1 p.m. (28th).	W.S.W.	—	—	—	—	10 p.m. (28th)	W. by N.	9	7 p.m. (28th).	W.	33	—

The effect of this disturbance on temperature was well marked. At Glasgow and Stonyhurst the thermometer rose rapidly just before, or with, the shift of wind to south, while at stations more remote from the centre the change was more gradual. Diurnal range was more or less obliterated in most places, and at Armagh the changes were very singular, the maximum temperature for the day occurring simultaneously with the minimum barometer at 2 a.m., followed by a rapid fall as the barometer rose and the wind veered to the northward of west. Fig 27, Plate XLVIII. for 6 p.m. on the 28th, shows that while the centre of depression had advanced slightly to the eastward, the barometer had risen on our north-west coasts, so that the gale at Holyhead had veered to north, while a W.N.W. gale set in at Yarmouth. Aurora was seen on the 28th and 29th at Markree (Sligo), and by Capt. Watson, S.S. "Palmyra," on the 29th near the Tuskar. Rain fell heavily at all the N.W. and N.E. stations, and to a less extent elsewhere. As the disturbance passed off the weather cleared considerably.

August 29. The depression lay over Holland at 8 a.m. and had become more serious, but the failure of the continental reports renders it impossible to draw a chart It was blowing very hard from W. at Brussels, and a strong northerly gale was reported at the Helder, with a tremendous sea, and the sea was very rough on our E. coast also, where a N.N.E. gale had been felt at Scarborough during the night. The barometer now rose briskly in all parts of this country until midnight of the 30th, and northerly winds again prevailed.

At about 10 p.m. on Aug. 30th a fresh decrease of pressure set in over the west and north of the British Isles, extending to the other parts of this country by midnight, while in Norway the barometer continued to rise till the following day. This diminution continued steadily, see Plate XLIX., until the minimum reading was reached at each observatory, as follows:—

Valencia	7.30 p.m., 1st.
Armagh	Midnight, 1st.
Glasgow	3 a.m., 2nd.
Stonyhurst	About 5 a.m., 2nd.
Falmouth	
Aberdeen	6 a.m., 2nd.
Kew	2 p.m. „

The conditions of pressure at 8 a.m. on the 1st are shown on Fig. 28, Plate XLIX.

At all the northern and western stations the fall became rapid shortly before the minimum was reached, and at Valencia at the time of the minimum a sudden dip is observable which is noticed with some slight modifications at Stonyhurst, Glasgow, and Aberdeen. At Armagh and Falmouth it is less marked, and is scarcely traceable at Kew. Temperature varied very much; the usual fall at night being hardly noticeable at Valencia on the 31st Aug., as well as at Aberdeen and Stonyhurst on the 1st Sept., while elsewhere the daily range was considerably modified. The tension of vapour increased. The wind shifted to S., rapidly in most places, rising to a moderate gale in the S. of Ireland, and, for a short time, in the Irish Sea also. At Valencia a maximum of 43 miles an hour from S. by W. was reached at 5 a.m. on the 1st, and at Holyhead 53 miles from S.S.E. at midnight of the same day. At no other observatory did the velocity exceed 35 miles, though on nearly all our coasts a distinct freshening of the wind is noticed. In the north of Scotland light easterly airs showed themselves.

At Aberdeen, however, the fall of the barometer exhibits a singular interruption between noon and midnight of the 31st, with some unsteadiness of pressure after 9 p.m., the wind gradually dying down, and not freshening again till the fall was continued on the morning of the 1st. A similar unsteadiness is noticed in the Valencia barogram, at about 2 p.m. on the 1st, which is shown later in the day at Armagh, Stonyhurst, and Falmouth.

It seems, from Professor Mohn's Reports, that during the night of the 31st a separate disturbance crossed the south of Norway, where the barometer fell more rapidly than could result from the mere extension of the depression noted above, and the wind freshened from *west* on the morning of the 1st. A similar freshening from the westward had occurred at Sandwick and Alnwick Castle in the afternoon of the 31st.

After a very slight recovery in most places the barometer remained low for some time, and at Armagh and Glasgow there is a distinct second minimum shown, between 4 and 6 p.m. on the 2nd, accompanied by a slight freshening in the wind.

Sept. 2. Fig. 29, for 8 a.m. on this day shows a very considerable reduction of pressure when compared with the preceding day, while the gales have disappeared At 4 p.m. a more decided recovery set in at Armagh, gradually extending to all parts of the British Isles, and reaching Kew at about 7 a.m. on 3rd, and from Fig. 30, Plate L we see that the centre of depression which lay off the north-west coast of Scotland on the 2nd had advanced to the North Sea. This change, which was marked by a general decrease of temperature and vapour tension, terminated at Valencia at 9 p.m. on the 3rd, and at Kew at 10 a.m. on the 4th. The wind drew into N.W., blowing freshly on all our west coasts, and a velocity of 43 miles was reached at Sandwick at 4 a.m. on the 4th In the Bay of Biscay strong westerly breezes were reported, and a fresh S.W. wind at Helder.

It is worth noting that at each observatory, *before* the barometer had reached its maximum height, the wind had begun to "back" again, and at the time of the maximum was again westerly or south-westerly everywhere.

No sooner had this disturbance passed off than a new depression approached our western coasts. At 10 p.m. on the 3rd the barometer began to fall again at Valencia, and in the course of the next 12 hours the decrease had become general over the British Isles.

At 8 a.m. on the 4th pressure was greatest (and very uniform) over Spain, the south of France, and Germany, lowest over the north of the British Isles and Norway. The wind had backed to S. or S.W. on our western coasts, and was fresh in Ireland; but moderate westerly breezes prevailed in England, and light airs on the coasts of the Bay of Biscay and over France. The barometer, however, continued to fall fast in this country. At 8 a.m. on the 5th, Fig. 31, the "gradient" from Cape Gris-Nez to Greencastle was 10. Temperature and vapour tension increased everywhere, and the wind, which was strong from S.W. on our west coasts, rose to a moderate gale during the day, which extended as a strong breeze to the N.E. coasts of England and Scotland. The following table gives the principal features of the wind in this gale.

Observatories, Sept.	VELOCITY. 30-40 Miles per Hour.		VELOCITY. Exceeding 40 Miles per Hour.				VELOCITY. Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	MAXIMUM VELOCITY.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	3 a.m. (4th).	S.	11 a.m. (4th).	S.	45	7	9 p.m. (4th)	S.S.W.	32	3 p.m. (4th).	S.	52	Wind fell below 30 miles 9 p.m. to 11 p.m. of 4th.
	11 p.m. (4th)	S.S.W.	4 a.m. (5th).	S.W. by S.	45	2	10 a.m. (5th)	S.W.					
Glasgow -	11 a.m. (5th).	S. by W.	—	—	—	—	4 p.m. (5th)	S.W. by S.	5	1 p.m. (5th).	S. by W.	40	The wind blew freshly at times during the 4th and early on the 5th, but did not exceed 30 miles per hour for long together.
Falmouth -	11 p.m. (4th).	S.	—	—	—	—	6 a.m. (5th)	S.W. by S.	5	4 a.m. (5th).	S. by W.	36	—
Holyhead -	10 a.m. (4th).	S.	1 p.m. (4th).	S.	47	14	9 p.m. (5th)	S.	35	Midnt. (4th). 2 a.m. (5th).	S. by E.	52	Fell below 30 miles per hour between 4 a.m. and 7 a.m. 5th. Wind southerly all the time.
			11 a.m. (5th).	S.	42	3							
Alnwick Castle	11 a.m. (5th).	S.W. by S.	—	—	—	—	7 p.m. (5th)	S.W. by S.	8	3 to 5 p.m. (5th).	S.W. by S.	39	Wind blew 36 miles per hour from S.W. by S. at 4 p.m. on 4th also, for an hour only.

At Ardrossan force 10, (Beaufort scale), was reached on the morning of the 4th, which is greatly in excess of the maximum registered at Glasgow.

The minimum pressure was reached at Valencia at 4 a.m. on 5th, Armagh 11 a.m., Glasgow 3 p.m., Aberdeen 4.30 p.m. At Valencia, Glasgow, and Aberdeen a few hours before the minimum was reached the fall was checked considerably, during which time the wind lulled in a marked manner, but increased again when the fall was resumed. At Armagh the decrease was steady, while at Falmouth and Stonyhurst, it was checked at about 3 a.m. on the 5th, from which time the mercury fell only slowly until about midday on the 7th. Rain was very general on the 4th and 5th. On the night of the 3rd a very brilliant aurora was seen in Scotland, Ireland,

and Wales, and great magnetic disturbance was reported from Aberdeen. Lightning and thunder occurred in the south of Ireland, and also at Alnwick, at 3 p.m. on the 5th.

Barometrical pressure now remained low on our western and northern coasts until Sept. 7th, while over Europe it decreased slowly. Greater uniformity was thus produced, and the wind fell light, varying much in the south of Ireland between the evening of the 5th and morning of the 8th. The weather was showery generally. Thunderstorms occurred on our western coasts on the 6th, and in the north of Scotland on the 7th. Very stormy weather was, however, prevalent off the north-west coast of Spain, and at about 2 a.m. on the 7th H.M.S. " Captain " foundered off Cape Finisterre in a heavy gale from the W.S.W. This gale reached Rochefort in the course of the day, but the French telegraphic reports are so imperfect that we cannot trace its history.

Sept. 7. At 8 a.m. pressure was on the whole highest over the Adriatic, and lowest to the northward and westward of the British Isles, where, however, a slight recovery set in later in the day. A local depression (about 28·9 ins.) lay over the south of Norway, producing strong S.W. to N.W. winds in that neighbourhood, and a southerly gale at Oxö. An aurora was seen at Roche's Point in the evening, with lightning there, in London, and in Scotland, and squally, showery weather was rather prevalent during the day.

Sept. 8. At 8 a.m. the barometer had risen nearly half an inch in the west, and to a less extent elsewhere. The wind was blowing from N.W., moderate to fresh generally, squally in the north and east of Great Britain, with cloudy weather. In the west of France it was strong from W. This state of things did not last long, for at 9 a.m. a very sudden diminution set in at Valencia, with a shift of wind to S.E. Capt. Kennedy, in the S.S. " Scotia," when 300 miles W.S.W. of Valencia, had experienced a similar change about five hours earlier. This fall of the barometer extended very rapidly to the other observatories, and Fig. 32, Plate LI., shows the conditions of pressure at 6 p.m. The curve of 29·6 takes a remarkable course, the northern portion of it being influenced by the previous barometrical disturbance, whose centre was now situated over the south of Norway. The minimum reading was reached at Valencia by midnight, when the centre of lowest pressure was apparently some considerable distance to the westward of that observatory, and the S.S. " Idaho," off the south-west coast of Ireland, was experiencing a heavy gale from W.S.W.

Sept. 9. At 9 a.m., Fig. 33, the centre of the storm was near Greencastle, and apparently travelling north-eastwards. The barometer then commenced rising both at Valencia and Armagh. The wind was strong from the westward in the south of Ireland, fresh to strong from S.W. and S. in the Irish Channel and England, but moderate from S.E. and E. in the north of Scotland. During the day, however, it increased in force, very seriously on the north-west coast of Ireland and the west coast of Scotland, and from about noon a very severe southerly gale blew over the districts in question, causing a large number of casualties to shipping and some loss of life.

The storm does not seem to have continued on its north-easterly track long, but, after halting for a short time, to have changed its course and travelled almost due east, the centre passing right over Glasgow at about 1 a.m. on the 10th. In consequence of this we have two distinct minima of pressure, shown in Plate LI., at Stonyhurst, Armagh, Glasgow, and Aberdeen, the second being very distinct and sudden at Glasgow, where it was accompanied by a lull of the southerly wind, followed by a sudden shift to N. At 8 a.m. on the 10th, Fig. 34, the disturbance lay slightly to the eastward of the coast of Northumberland, and a westerly gale was blowing over all the southern parts of the country, with moderate N. and N.E. winds in Scotland. The principal features of the wind in this storm are shown in the following table, and it is not a little remarkable that the velocity did not exceed 50 miles an hour at any station except Holyhead.

Observatories, Sept.	Velocity, 30-40 Miles per Hour.		Velocity, Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours, the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	Noon (8th).	S.E.	Midnt. (8th).	S. by W.	43	1	5 a.m. (10th)	W.N.W.	41	Midt. (8th).	S. by W.	43	Velocity fell below 30 miles between 8 and 11 a.m. on the 9th.
Armagh -	9 a.m. (9th).	S.W.	—	—	—	—	11 p.m. (9th)	W.S.W.	14	2 & 3 p.m. (9th).	S.W.	40	—
Glasgow -	Noon (9th).	S.S.W.	—	—	—	—	Mid. (9th)	S. by E.	12	4—5 p.m. (9th).	S.S.W.	40	Sudden lull at midnight of 9th, followed by shift to N. at 1 a.m. 10th.
Aberdeen -	7 a.m. (9th).	S.E.	11 a.m. (9th).	S.E.	42	2	2 p.m. (9th)	S.	7	11 a.m. & noon.	S.E.	42	—
Sandwick -	10 a.m. (9th).	E. by S.	—	—	—	—	4 p.m. (9th)	E	6	10 a.m. & 3 p.m. (9th).	E.	32	Wind was below 30 miles at 11 a.m. and noon.
Falmouth -	7 p.m. (8th).	S.E. by S.	—	—	—	—	9 p.m. (8th)	S. by E.	2	7 p.m. (8th).	S.E. by S.	36	—
	3 a.m. (9th).	S.W.	—	—	—	—	7 p.m. (9th)	W. by S.	16	1 p.m. (9th).	S.W. by W.	36	Velocity below 30 miles, 8 to 10 a.m. 9th.
Holyhead -	1 a.m. (9th).	S.E. by S.	2 a.m. (9th). 4 p.m. (9th).	S. by E. S.W. by S.	45 52	1 18	2 p.m. (10th)	W. by N.	37	9 to 11 p.m. (9th).	S.W. by S.	57	Wind *veered* gradually round.
Stonyhurst -	9 p.m. (9th).	S.W. by W.	3 & 5 a.m. (10th).	W.S.W.	41	2	8 a.m. (10th)	W. by N.	11	3 & 5 a.m. (10th).	W.S.W.	41	—
Alnwick Castle	Noon (9th).	W.S.W.	—	—	—	--	5 a.m. (10th)	W.	17	2 to 4 p.m. (9th).	S.W. to W.S.W.	40	Wind fell light, without change of direction, from 6 p.m. to midnight 9th.
Yarmouth -	5 a.m. (9th).	S.E. by S.	—	—	—	—	7 a.m. (9th)	S.S.W.	2	5 a.m. (9th).	S.E. by S.	35	—

At Hawsker, near Whitby, 837 miles of wind passed over the anemometer during the day (10th), as reported by Mr. Stow, being an average of about 35 miles an hour, from points between S.S.W. and N.W. Rain fell generally during the storm, and in some places heavily.

The barometer then rose fast, and by the morning of the 11th all trace of the storm had disappeared from our own and the French coasts.

Sept. 11, 8 a.m. An anticyclone, in the centre of which pressure was 30·2 in. and upwards, had formed at the entrance of the English Channel, so that while light westerly and north-westerly winds blew over the British Isles, moderate easterly breezes were observed in the west of France, the weather being fine generally.

Sept. 12. The barometer this morning stood highest over central and southern Europe and lowest in the north of the British Islands, where it had been falling since noon of the previous day. The weather was on the whole cloudy, with squalls and rain in some parts of Scotland, where the wind had backed to south for a time during the night. Its force at 8 a.m. was moderate, and its direction between W. and S. in the United Kingdom, but about 130 miles W.N.W. from Malin Head Capt. Thompson, of the S.S. "American," had a strong N.W. breeze. During the day a slight depression crossed Scotland from the westward, its influence being shown by all the barograms except Falmouth. This disturbance seems then to have travelled across the North Sea to Norway by 8 a.m. of the 13th, the wind veering to W. again as its centre passed to the eastward of the different stations. Rain fell on our western and northern coasts, and a thunderstorm occurred at Roche's Point. To this succeeded another slight depression which crossed the northern parts of our islands late on the 13th, and apparently followed a south-easterly course.

Both of the above disturbances were slight, though on some parts of our N.W. coasts heavy westerly squalls were reported on the 13th, and a large amount of rain fell in Scotland and the north-west of England.

The barometer now rose generally, the change commencing in the north-west of Ireland shortly after noon of the 14th. The weather was fine, but overcast in the south-west, with fog in some places.

Sept. 16.* The barometer was uniformly high. A slight anticyclone lay over the S.E. of England. The wind was light, circulating round the maximum pressure. The sky was nevertheless very cloudy, with rain in the north-west. Pressure was already giving way a little at Thurso.

Sept. 17. At 8 a.m. the barometer had fallen nearly 0·4 in. in the W. of Norway, with a fresh southerly wind; but readings in these islands were scarcely changed. The wind, however, drew into W. in Scotland and the N. of England, and the weather continued cloudy on our western coasts.

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* Information from the continent became very scanty and unreliable about this time, in consequence of the telegraphic interruptions caused by the war, so that for the present the remarks made here must refer more exclusively to the British Islands and their immediate neighbourhood.

After a very slight but general decrease of pressure on the 18th and part of the 19th, the barometer again rose slowly, remaining high and very steady till the 24th. Temperature was on the whole rather above the average, and the weather fine. Moderate easterly winds prevailed in the S. of England, the English Channel, and west of France, drawing to S.E. or S. in Ireland, while in Scotland the wind was very light and variable in direction. On the night of the 22d the southerly wind freshened considerably in the S. of Ireland, and blew rather strongly from S.E. on the 23rd, during which time there was a little diminution of pressure shown at Valencia.

With the exception of a trifling fall of the barometer in Scotland on the 26th, pressure remained high everywhere till the end of the month, with light variable airs and fine but hazy weather. Brilliant auroral displays were observed in Scotland, Ireland, Wales, and the W. and N. of England, on the 24th and 25th; that on the 24th being the brightest, and being also seen on board the S.S. "Moravian," about 300 miles to the westward of the Scotch coast. Slight displays were noted in various places on the 27th and 30th also. Fog was very prevalent on the 29th and part of the 30th, and on the latter day, though light variable airs were general on our coasts, a southerly gale was reported by Capt. Leportier, of the ship "Kate," in latitude 60° N., longitude 14° W.

REMARKS.

Wind.—The following table gives the number of hours during which the wind reached the velocity of 30 miles or upwards per hour, irrespective of its direction, during each month, and in the entire quarter.

Observatory.	July.	Aug.	Sept.	Total.	Observatory.	July.	Aug.	Sept.	Total.
Valencia - -	33	5	115	153	Holyhead - -	36	41	128	205
Armagh - -	0	0	14	14	Stonyhurst -	0	0	17	17
Glasgow - -	8	1	28	37	Alnwick Castle -	28	8	37	73
Aberdeen - -	2	0	12	14	Kew - - -	0	0	3	3
Sandwick - -	34	8	1	43	Yarmouth - -	9	7	16	32
Falmouth - -	32	22	45	99					

Holyhead again shows the highest number, but the quiet state of the atmosphere, especially in July and August, is conspicuous everywhere.

Pressure.—

July.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	Inches.	Inches.	Inches.	D. H.	Inches.	D. H.	Inches.
Valencia - -	30·022	+0·006	30·354	19th, 10 p.m.	29·713	12th, 10 a.m.	0·641
Armagh - -	29·995	+0·080	30·330	28th, 9 a.m.	29·643	4th, 4 a.m.	0·687
Glasgow - -	29·961	+0·089	30·329	28th, 8 a.m.	29·545	4th, 8 a.m.	0·784
Aberdeen - -	29·942	+0·064	30·338	28th, 9 a.m.	29·459	4th, 10 a.m.	0·879
Falmouth - -	30·037	−0·011	30·369	19th, midgt. 20th, 8 a.m.	29·714	25th, 2 a.m.	0·655
Stonyhurst -	29·991	+0·081	30·311	19th, midngt.	29·688	4th, 7 a.m.	0·623
Kew - - -	29·993	+0·009	30·318	20th, 8 a.m.	29·664	12th, 3 a.m.	0·654

Pressure was very slightly above the average, except at Falmouth, the excess being greatest in the north-west. The maximum in the month occurred at the northern observatories on the 28th, but at the southern and western on the 19th and 20th. The minimum was registered in the north on the 4th. The range was very small, and was largest at Aberdeen.

August.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	Inches.	Inches.	Inches.	D. H.	Inches.	D. H.	Inches.
Valencia - -	30·041	+0·077	30·398	30th, 10 p.m.	29·544	5th, 4 a.m.	0·854
Armagh - -	30·030	+0·176	30·388	11th, 11 a.m.	29·432	28th, 2 a.m.	0·956
Glasgow - -	30·012	+0·195	30·420	14th, 6 a.m.	29·516	28th, 4 a.m.	0·904
Aberdeen - -	30·009	+0·175	30·427	13th, 10 p.m.	29·607	28th, 7 a.m.	0·820
Falmouth - -	30·036	+0·021	30·382	30th, 11 p.m.	29·593	7th, 3 a.m.	0·789
Stonyhurst - -	30·002	+0·117	30·360	13th, 8 a.m.	29·288	28th, 7 a.m.	1·072
Kew - - -	29·991	+0·035	30·342	30th, midt.	29·429	28th, noon	0·913

Atmospherical pressure was above the average at all observatories, the difference being greatest in the north. The maximum for the month was registered in the north between the 11th and 14th, and in the south on the night of the 30th, while the minimum occurred on the 28th, except at Valencia and Falmouth. The range was greatest at Stonyhurst.

September.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	Inches.	Inches.	Inches.	D. H.	Inches.	D. H.	Inches.
Valencia - -	30·014	+0·179	30·490	16th, 10 p.m.	29·138	8th, midngt.	1·352
Armagh - -	29·995	+0·144	*30·530	30th, midngt.	28·951	9th, 7 a.m.	1·579
Glasgow - -	29·963	+0·161	*30·551	30th, midngt.	28·692	10th, 1 a.m.	1·859
Aberdeen - -	29·931	+0·119	*30·560	30th, midngt.	28·918	9th, midngt.	1·642
Falmouth - -	30·091	+0·081	30·531	16th, 9 p.m.	29·346	7th, 6 a.m.	1·185
Stonyhurst -	30·037	+0·131	*30·599	30th, midngt.	29·118	10th, 2 a.m.	1·481
Kew - - -	30·095	+0·121	*30·556	16th, 10 a.m.	29·328	7th, 5 p.m.	1·228

* These figures differ from those given in Table I. Appendix I., which is compiled for astronomical time.

Pressure was again in excess of the average at all observatories, the variation being least at Falmouth. The maximum for the month occurred in the north on the 30th, and in the south of our islands on the 16th, while the minimum was registered at all observatories between the 7th and 10th. The range was considerable, especially at Glasgow, where its amount is mainly due to the depression which passed over that station at 1 a.m. on the 10th.

Temperature.—

July.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	°	°	°	D. H.	°	D. H.	°
Valencia - -	60·9	+0·9	79·6	24th, 1 p.m.	51·2	2nd, 5 a.m.	28·4
Armagh - -	60·5	+0·1	79·6	23rd, 2 p.m.	45·0	27th, 5 a.m.	34·6
Glasgow - -	59·6	+2·8	84·5	24th, 4 p.m.	46·7	3rd, 5 a.m. 29th, 6 a.m.	37·8
Aberdeen - -	58·5	+2·6	74·0	23rd, 3 p.m.	47·0	2nd, 10 p.m.	27·0
Falmouth - -	62·3	—	74·2	25th, 2 p.m.	52·7	2nd, 3 a.m.	21·5
Stonyhurst - -	61·2	+3·4	80·8	25th, 3 p.m.	46·5	29th, 5 a.m.	34·3
Kew - - -	65·9	+4·4	85·4	22nd, 3 p.m.	46·0	2nd, 2 a.m.	39·4

The weather was warm everywhere during the month, especially in England. The maximum was reached between the 22nd and 25th, and was highest at Glasgow and Kew. The minimum was reached in most places on the 2nd, but at Armagh on the 27th, and at Stonyhurst and Glasgow on the morning of the 29th. At Glasgow a similar minimum had occurred on the 3rd. There is a considerable difference between the value of the minima in the south-west and those elsewhere. The range was greatest at Kew, and least at Falmouth.

August.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	°	°	°	D. H.	°	D. H.	°
Valencia - -	61·6	+2·7	77·6	13th, 1 p.m.	46·2	31st, 3 a.m.	31·4
Armagh - -	58·8	−0·1	78·0	10th, 4 p.m.	42·4	30th, 6 a.m.	35·6
Glasgow - -	57·7	+0·6	77·6	10th, 4 p.m.	40·9	27th, 5 a.m. 29th, 6 a.m.	36·7
Aberdeen - -	56·1	+0·1	67·9	31st, 2 p.m.	44·8	29th, 2 a.m.	23·1
Falmouth - -	61·7	—	76·3	11th, 1 p.m.	48·5	31st, 5 a.m.	27·8
Stonyhurst - -	59·0	+1·8	78·9	2nd, 4 p.m. 12th, 3 p.m.	37·8	31st, 6 a.m.	41·1
Kew - - -	61·1	+1·1	78·3	6th, 4 p.m. 18th, 3 p.m.	42·2	31st, 6 a.m.	36·1

Temperature was slightly above the average, except at Armagh. At the western and north-western observatories the maximum took place between the 10th and 13th, while the minimum was registered everywhere during the last day or two in the month. The minimum at Stonyhurst was very low, and the greatest range is thus found at this observatory, while the least occurs at Aberdeen.

September.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	°	°	°	D. H.	°	D. H.	°
Valencia - -	58·6	+2·2	71·0	22nd, 2 p.m.	45·2	11th, 3 a.m.	25·8
Armagh - -	55·4	+0·2	69·6	22nd, 2 p.m.	*43·0	15th, 6 a.m.	26·6
Glasgow - -	53·4	+0·1	66·9	23rd, 2 p.m.	36·3	15th, 6 a.m.	30·6
Aberdeen - -	54·2	+1·6	66·9	29th, 3 p.m.	38·8	9th, 1 a.m.	28·1
Falmouth - -	58·5	—	67·1	2nd, 1 p.m.	50·0	11th, 4 a.m.	17·1
Stonyhurst - -	54·4	+0·5	67·7	27th, 3 p.m.	36·4	15th, 5 a.m.	31·3
Kew - - -	55·5	−0·8	70·8	28th, 2 p.m.	38·4	15th, 5 a.m.	32·4

* This value differs from that given in Table I. Appendix I., which is compiled for astronomical time.

In September temperature was on the whole very near the average—slightly above it, except at Kew, where it was rather below it. The time of the maximum varied considerably, except in Ireland and the west of Scotland, where it occurred on the 22nd and 23rd. The minima were registered on the morning of the 15th in the north-west, and also at Kew. The small extent of the range at Falmouth, owing to the high minimum temperature, is very remarkable. The greatest range was observed at Kew.

The following comparison of the five-day means at Kew with those for Greenwich has been drawn out as in the previous numbers.

Date.	Variation.	Date.	Variation.	Date.	Variation.
	°		°		°
June 30–July 4	− 1·6	July 30–Aug. 3	+ 3·3	Aug. 29–Sept. 2	− 2·0
July 5–9 -	+ 5·0	Aug. 4–8 -	+ 3·2	Sept. 3–7 -	− 0·7
„ 10–14 -	+ 3·1	„ 9–13 -	+ 3·2	„ 8–12 -	− 1·3
„ 15–19 -	+ 5·0	„ 14–18 -	+ 0·4	„ 13–17 -	− 3·2
„ 20–24 -	+ 9·4	„ 19–23 -	− 3·7	„ 18–22 -	− 1·4
„ 25–29 -	+ 2·1	„ 24–28 -	− 1·7	„ 23–27 -	− 1·5

This shows us that the first five days in July were rather cold. A warm period then intervened, lasting till the middle of August, the greatest excess being from 20th to 24th of July. A rather cold time then followed, and lasted till the end of the quarter.

PART 4.

Oct. 1. Atmospherical conditions were very similar to those which marked the last few days of September. The barometer was high and steady. An anticyclone, whose maximum pressure was nearly 30·7 ins., lay over the North Sea, where the readings were half an inch higher than those in the south-west of France. Temperature was high. The winds were light to fresh from E. in the south of Ireland, the English Channel, and Bay of Biscay, light from S.E. and S. on our N.E. coasts, and from S.W. in the south of Norway. The weather was fine but rather foggy, and the sea calm. The freshening of the easterly wind in the daytime is shown very clearly on each of the first few days at Kew and Aberdeen, and to a less extent at several of the other observatories.

From the 1st to the 4th very little change took place in these islands; however a severe westerly gale was blowing in the extreme north of Norway. On the 2nd the wind became for a time rather more southerly on our south-west coasts, and freshened. Fog increased generally, and aurora was seen at Sandwick Manse and Thurso on the night of the 1st and 2nd. On the 4th, however, cloud began to increase very much in the west and north; lightning was seen in the south of Ireland; and pressure, which commenced falling in the west of Norway on the 3rd, began to give way over the North Sea. By midnight the fall became general.

This barometrical decrease (*see* Plate LVI.) is remarkable for its great regularity until about mid-day of the 7th, readings consequently remaining very uniform over our islands till that time, though the change was more rapid in Norway. The wind became moderate from S.E., except in the north, where it was light from the northward. A little rain fell in the north-west and north on the 6th, and the sky was overcast generally.

Oct. 7. In the afternoon the mercury fell quickly on our south-west coasts, and during the night an elongated area of depression advanced over those parts of the kingdom. The minimum pressure was reached at Valencia by about 8 a.m. on the 8th, at which time a very sudden change of wind from a light easterly air to a moderate westerly breeze and a clearing up of the weather seem to indicate that the centre of the disturbance had passed over the observatory. At this hour the district of depression stretched from W.S.W. to E.N.E. across the south of Ireland, and even as far as Holyhead (*see* Fig. 35, Plate LVII.). To the southward and south-eastward pressure increased to 29·9 in. over the Mediterranean, while to the north-eastward it rose until we find between Scotland and Norway, a region of *comparatively* high pressure, from which, proceeding still further to the north-eastward, the barometer was lower again. The wind was moderate to strong from the west and south in the English Channel, with a considerable quantity of rain, strong easterly winds prevailed in the north of England, reaching the force of a strong gale at Scarborough and Greencastle, while in Norway the wind was N.W. On our southern coasts the strongest wind experienced was that from the southward, which reached the velocity of 33 miles an hour at Falmouth at 4 p.m., 7th, blew a fresh gale at Portsmouth on the morning of the 8th, and attained a velocity of 40 miles an hour from S.E. at Yarmouth at the same time. The rain which accompanied the disturbance was very heavy on our S.W. coasts, and also at Ulceby in Lincolnshire, where 3·4 in. fell in the 48 hours ending 8 a.m. on the 8th. Stonyhurst records 3·6 ins. between the 7th and 9th. In the north very little was reported.

Oct. 9th. The depression had travelled eastwards, and lay off the coast of Norfolk (*see* Fig. 36, Plate LVII.). At Yarmouth the barometer fell to 28·9 in. (which is rather lower than that recorded at Valencia on the previous day), and pressure gave way over France. The gale subsided on our coasts, but the wind continued to circulate round the minimum pressure, and blew hard from W. in the S.W. of France, and from S.W. at Hamburg. Rain fell again, chiefly in the north-east of England, and hail at Aberdeen. The general recovery of the barometer was scarcely perceptible until the 9th, and at the English observatories it was preceded by a second minimum, which is also shown very slightly at the Irish stations, but not at Aberdeen. After this the rise became general, and proceeded continuously during the 9th and 10th. As the disturbance continued its eastward course, the northerly wind freshened to 33 miles an hour at Orkney by 3 p.m. on the 9th, and to 43 miles at Holyhead by 1 a.m., and a similar increase was reported at Scarborough in the afternoon, and at Helder (from N.W.) at 8 a.m. on the 11th.

Oct. 11th. The weather had cleared up on all our coasts. Barometrical readings were comparatively uniform over the British Isles and France, but continued lower in Norway. The glass was still rising at the northern and eastern observatories, but in the south-west the maximum had passed and a slow descent had commenced. The wind in most parts of the country was moderate from N.W., but had veered to N.E. in the S.W. of England, and to E. in the south of Ireland, with an increase of cloud. In the afternoon the wind drew to S.E. on all our south-west coasts, and the sky became overcast with a rise of temperature. At 3 p.m. the fall of the baromer became rapid at Valencia, extending to all parts of the country by midnight. A serious depression advanced from the south-south-westward on the Irish coasts, as is shown by the chart for 6 p.m. Fig. 37. The minimum reading was reached—

At Valencia and Falmouth	about 8 a.m.	12th.
Kew	0 40 p.m.	,,
Armagh	5 p.m.	,,
Glasgow	9 ,,	,,
Aberdeen	11 ,,	,,
Stonyhurst	2 a.m.	13th.

The irregularity of these times is very remarkable, but it seems to be explained by the unusual course followed by the storm, as explained in the sequel.

Oct. 12. At 8 a.m., Fig. 38, the centre of the depression was apparently somewhere off Galway Bay. A hard southerly gale had set in on the S. coast of Ireland and in the St. George's Channel, extending as a strong and squally south wind along the S. of England and W. of France; but at Valencia the wind had already veered to W.S.W., while in the N. of Ireland it blew hard from the eastward. The sky was overcast; rain fell everywhere but in the N.E., and a tremendous sea ran on the S. coast of Ireland. As the day advanced the disturbance travelled north-eastward (Fig. 39, Plate LVII.) and at 5 p.m. the centre passed between Armagh and Greencastle, as we see by the shifts of wind observed. The wind rose to a stiff S.E. gale, with rain, on our north-east coasts. In the S. and central parts of Ireland it had veered to W. and continued to blow with great violence, while in the English Channel a fresh W.S.W. gale set in. On reaching the North Channel the storm suddenly changed its course and travelled south-eastwards, the centre passing between Shields and Stonyhurst, very near the latter, apparently over, or exceedingly close to Scarborough, and was off the coast of Lincolnshire on the following morning Fig. 40, Plate LVIII. The rain which accompanied the storm was heaviest in the north-west, exceeding an inch at Greencastle and Armagh, and 1·8 in. at Stonyhurst. Thunder occurred at Valencia.

The following table gives the principal features of the wind in this gale.

Observatories, Oct. 11-13, 1870.	Velocity, 30-40 Miles per Hour.		Velocity, Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	7 p.m. (11th).	E. by S.	1 a.m. (12th).	S.E.	51	17	10 p.m. (12th)	W. by N.	27	9 a.m. (12th).	S.W.byW.	63	Slight lull 8 to 10 p.m. on 11th.
Armagh -	—	—	—	—	—	—	—	—	—	8 a.m. (12th).	E. by S.	35	Blowing gustily from between E. by S., and S. by W. at times from 8 a.m. to 4 p.m. 12th.
Glasgow -	11 a.m. (12th).	E. by N.	—	—	—	—	8 a.m. (13th)	N.N.E.	21	11 p.m. (12th).	N.E.	43	This velocity was only reached for one hour.
Aberdeen -	9 a.m. (12th).	S.E. by S.	9 p.m. (12th).	E.S.E.	43	8	9 a.m. (13th)	E.N.E.	24	10 p.m. (12th).	E.	49	Wind rose to 43 miles from S.E. for one hour only, at 5 a.m. 12th.
Sandwick -	8 p.m. (12th).	E.	—	—	—	—	11 p.m. (12th)	E.	3	9 p.m. (12th).	E.	31	—
Falmouth -	10 p.m. (11th).	S.E.	Noon (12th). 9 a.m. (13th).	W.S.W. W.	43 42	9 4	4 p.m. (13th)	W. by N.	42	1 p.m. to 4 p.m. (12th)	W.S.W.	46	The velocity *reached* 40 miles from S.S.E. at 4 and 8 a.m. on 12th, and also from S.W. by S. at 8 a.m. There was a distinct lull from 9 p.m. 12th to 8 a.m. 13th.

Observatories. Oct. 11-13, 1870.	Velocity, 30-40 Miles per Hour.		Velocity Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours, the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Holyhead -	5 a.m. (12th).	E.S.E.	8 a.m. (12th).	S.E.	56	24	5 p.m. (13th)	N.N.E.	36	7 p.m. (12th) 1 a.m. (13th)	S.W. by S. W. by S.	66	Velocity reached 58 miles from S.E., also at 9 a.m. 12th.
Stonyhurst -	—	—	—	—	—	—	—	—	—	1 a.m. (13th).	S.W.	31	For 1 hour only.
Alnwick Castle	11 a.m. (12th).	S.S.E.	—	—	—	—	5 p.m. (12th)	S.E.	6	2 p.m. (12th).	S.S.E.	40	Wind again rose to 34, miles from N.E. by N. for one hour only, at 6 a.m. 13th.
Kew - -	8 p.m. (12th).	S.W.by S.	—	—	—	—	4 a.m. (13th)	W.S.W.	8	9 & 10 p.m. (12th).	S.W.	36	—
Yarmouth -	9 a.m. (12th).	S. by E.	10 a.m. (12th).	S. by E.	50	5	3 p.m. (12th)	S. by W.	6	Noon and 1 p.m. (12th)	S.S.E.	53	—

Oct. 13th. The position of the depression at 8 a.m. is shown by the isobars, Fig. 40, Plate LVIII., and the gales then blowing by the arrows marked. It will be seen that the cyclonic circulation of the wind was complete, and extended as a northerly gale as far north as the Skager Rack; but on the whole the southerly and westerly winds appear to have been the most violent. Some idea of the severity of this storm may be gathered from the fact that, between the 11th and 13th, 118 casualties to shipping were reported to the Wreck Department of the Board of Trade, among which were 38 total losses. The number of lives lost was 81. The disturbance continued travelling south-eastwards, and the gales in these islands subsided. The weather cleared, and pressure increased rapidly.

The 14th passed off more quietly. Pressure and temperature were uniformly near the average. The weather was fine but cloudy in some places. A brilliant aurora was seen in the N. and W. of the British Islands at night, and also by the captains of the steamships "Samaria" and "Scotia" off the west coast of Ireland. The low range of temperature in Great Britain early on the morning of the 15th was accompanied by a clear sky, but low radiation fogs were very prevalent.

Oct. 15th. Pressure in these islands, though uniformly high, had been giving way again since midnight, but was as yet rising in Holland. At 10 a.m. Valencia again took the lead, with a rapidly falling barometer, a rising southerly wind, and rain. The other observatories soon followed, and an extensive depression travelled along our western coasts.

Fig. 41, Plate LVIII., shows the general conditions of pressure and wind at 8 a.m. on the 16th. The centre of the storm then lay a considerable distance to the westward of Scotland. Fresh S. and S.W. gales had blown on the coasts of Ireland, Wales, and the

N.W. of Great Britain, and a S.E. gale had set in over the northern parts of the North Sea, while strong W. and S.W. winds blew in the English Channel and west of France. Temperature rose generally, very rapidly in the N.E., and was high, especially for overcast weather. More than an inch of rain had fallen on our western coasts, and a less quantity elsewhere. The minimum pressure was reached at Valencia by noon and Falmouth at 6 p.m. At the other observatories the oscillation was more complicated, the decrease being at first decidedly and suddenly checked, after which the mercury fell much less rapidly to a more definite minimum, which was reached just before the general recovery set in. A careful examination of all the records shows that the centre of the disturbance, after travelling northwards until it was apparently near the north coast of Scotland, changed its course, and moving eastwards, crossed the North Sea towards the south of Norway.

Fig. 42, Plate LVIII., gives the position of the depression at 8 a.m. on the 17th, when a W.N.W. gale was blowing in the north-west of our islands and the north of England, while a strong E.S.E. gale was reported from Oxö and Skudesnaes. In the north of Scotland, however, the wind was moderate from south. The S.S. "Cordillera" in the south of the Bay of Biscay experienced a westerly gale with squalls and rain.

By 2 p.m., the centre having passed to the eastward of Thurso, the wind there also had shifted to N.W. and was blowing a moderate gale.

The following table gives the chief characteristics of the wind recorded by the different anemometers.

Observatories. Oct. 15-17, 1870.	Velocity, 30-40 Miles per Hour.		Velocity, Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia	10 a.m. (15th).	S.S.E.	1 p.m. (15th).	S.	46	18	8 a.m. (16th)	W.S.W.	22	3 p.m. (15th).	S.S.E.	50	Wind veered to westward in a lull between these two portions.
	5 p.m. (16th).	N.W.byW.	—	—	—	—	Midnt. (16th)	W.N.W.	7				
Armagh	—	—	—	—	—	—	—	—	—	—	—	—	Velocity of just 30 miles reached for two hours only (from S. by E.) at 9 a.m. 15th.
Glasgow	1 a.m (16th).	S.E.	—	—	—	—	6 a.m. (16th)	S. by E.	5	5 a.m. (17th).	W.N.W.	43	Force of N.W. wind very unsteady. The velocity only exceeded 40 miles for one hour.
	5 a.m. (17th).	W.N.W.	—	—	—	—	10 a.m. (17th)	W.N.W.	5				
Aberdeen	1 a.m. (16th).	S. by E.	5 a.m. (16th).	S.S.E.	43	5	11 a.m. (16th)	S. by E.	10	6 & 8 a.m. (17th).	S.S.E.	45	Nearly calm between these two parts. Shift S. by E. to W. was very sudden.
	9 a.m. (17th).	W.N.W.	—	—	—	—	4 p.m. (17th)	W.	7				
Sandwick	9 p.m. (15th).	S. by E.	2 a.m. (16th).	S.E. by S.	48	11	2 p.m. (16th)	S.S.E.	17	10 a.m. (16th).	S.E.	57	Lulled to S.E. by S., 8 miles at 10 p.m. 16th.
	11 a.m. (17th).	W ½ N.	Noon (17th).	W. ½ N.	43	10	5 a.m. (18th)	W.	18	4 p.m. (17th).	W. by N.	47	
Falmouth	11 p.m. (15th).	S.S.W.	11 a.m. (16th).	S.W. by S.	45	2	8 p.m. (16th)	W. by S.	21	11 a.m. (16th).	S.W. by S.	47	—

Observatories. Oct. 15–17, 1870.	Velocity, 30–40 Miles per Hour.		Velocity, Exceeding 40 Miles per Hour.				Velocity, Fell below 30 Miles per Hour.		Total No. of Hours, the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Holyhead	2 p.m. (15th).	S.S.E.	7 p.m. (15th).	S.S.E.	52	10	7 p.m. (16th)	S.S.W.	29	Midnight (15th).	S. by E.	61	Velocity 40 miles (S. by W.) at times between 10 a.m. and 3 p.m. 16th. Lull to 23 miles as wind veered towards W.
	10 p.m. (16th).	W. by S.	Midnt. (16th).	W. by S.	44	9	5 p.m. (17th)	W.	19	3 a.m. (17th).	W. by S.	47	
Stonyhurst	2 a.m. (16th).	S.S.E.	—	—	—	—	8 a.m. (16th)	S.	6	5 a.m. (16th).	S.S.E.	42	For one hour only.
Alnwick Castle	4 a.m. (16th).	S. by E.	—	—	—	—	7 a.m. (16th)	S. by E.	3	5 a.m. (17th).	S.W. by W.	42	For one hour only.
	4 a.m. (17th).	S.W.	—	—	—	—	3 p.m. (17th)	W. by N.	11				
Kew	2 p.m. (16th).	S.S.W.	—	—	—	—	6 p.m. (16th)	S.W. by S.	4	3 p.m. (16th).	S.S.W.	34	Cylinder unclamped on morning of 17th for 3 hours, when wind veered to W.
Yarmouth	8 a.m. (16th).	S.	—	—	—	—	2 p.m. (16th)	S. by W.	6	11 a.m. (16th).	S. ½ W.	34	Velocity very irregular. The maximum velocity from *W.* was only 26 miles.

Rain had again fallen generally, chiefly in the north-west.

Pressure now rose rapidly everywhere, but the improvement was of short duration, for by 10 p.m. the barometer at Valencia began to fall again under the influence of renewed bad weather, which was approaching the Irish coast.

Oct. 18. At 8 a.m. the barometer apparently stood highest over France and had risen very fast on the north and east coasts of England; but at our western stations the mercury was falling rapidly. Strong southerly winds were again blowing on our W. and S.W. coasts, with rain and a rough sea; and temperature, which had fallen on all our coasts as the previous storm had passed off, again rose fast, except in the north-east of Great Britain. The S.S. "Columbia," Capt. J. J. Small, was this morning off the N.W. coast of Ireland, steaming westwards, and at evening ran into a S.W. gale in 13° 3′ W., about half way between Rockall and the coast of Ireland.

The bad weather extended quickly to our other coasts, a southerly gale being felt in the north-east of Great Britain, and a S.S.W. gale in the English Channel during the succeeding day and night, while fresh S.E. breezes set in at the Norwegian stations on the following morning. At Bodö a S.E. gale had commenced which lasted for five days. Thunderstorms and hail occurred in the south of Ireland, and more rain fell.

Oct. 19. Fig. 43, Plate LIX., shows that this new disturbance was of a complicated nature. The gale noticed in the English Channel and N.E. of Great Britain on the previous day had subsided; but a W. to S.W. gale was still blowing on our south-western coasts, which extended along our north-western and southern coasts as the day wore on. The course of the isobars in the figure seems to indicate two distinct centres of disturbance in the one general depression, to the more northerly of which the gales of the 18th seemed to be owing; and on examining the barograms for Valencia and Armagh we find two distinct minima of pressure recorded, one on the 18th and the other on the 19th, with a very decided recovery between them, the same peculiarity being reproduced, with certain modifications caused by the varied positions of the observatories, at—

Falmouth at 7 p.m. 18th and 10 a.m. 19th.
Stonyhurst „ 1 a.m. and noon on the 19th.
Glasgow „ 2 a.m. and noon of the 19th.
Kew „ 3 a.m. and 1.30 p.m.

At the last-named place the recovery from the first minimum is not very clearly shown. At Aberdeen the barogram failed, owing to the clock stopping at the period during which the oscillation would have occurred. By 6 p.m. (on the 19th) the centre of the second of these disturbances was apparently over the Irish Sea (Fig. 44, Plate LIX.)'; but the changes shown in the barograms at the north-western observatories point to yet further disturbance occurring in that neighbourhood. During the night a N.W. gale set in on the north-coast of Ireland, and the S.S. "Cambria" was lost on the island of Innishtrahull in a heavy snowstorm. 180 lives were lost, only one person being saved.

The following table gives the principal features of the gales which occurred from the 18th to the 21st, in the same manner as in other cases.

Observatories, October 18th-20th.	VELOCITY. 30-40 Miles per Hour.		VELOCITY. Exceeding 40 Miles per Hour.				VELOCITY. Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	MAXIMUM VELOCITY.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia	4 a.m. (18th).	S.E.	6 a.m. (18th).	S.S.E.	45	11	9 p.m. (18th)	W. by S.	17	Noon (18th).	S.S.E.	48	2 a.m. to 10 p.m., 19th, velocity varying from 24 to 55 miles an hour.
	Midngt. (18th).	S.S.W.	2 a.m. (19th).	S. by W.	41	20	4 p.m. (20th)	N.W. by W.	40	Noon (19th).	S.W.byW.	55	
Armagh	—	—	—	—	—	—	—	—	—	1 p.m. (18th).	S.E. by S.	30	—
										11 a.m. (20th).	W. by N.	33	
Glasgow	7 p.m. (18th).	S.E. by S.	—	—	—	—	3 a.m. (19th)	W.S.W.	8	9 p.m. (18th).	S.E.	34	Lull at S.E. at midnight and 1 a.m. (19th), just before sudden shift to W.
Aberdeen	6 p.m. (18th).	S.S.E.	10 p.m. (18th).	S.S.E.	41	2	4 a.m. (19th)	S. by E.	10	11 p.m. (18th).	S.S.E.	42	—
Sandwick	7 p.m. (18th).	S.S.E.	9 p.m. (18th).	S.E.	44	7	7 a.m. (19th)	S.E. by S.	12	11-12 p.m. (18th).	S.E.	48	Wind veered to S.W. by S. at 10 a.m. 19th, then backed again.
	4 p.m. (19th).	S.E.	—	—	—	—	8 p.m. (19th)	E.S.E.	4	6 p.m. (19th).	S.E.	35	
Falmouth	11 a.m. (18th).	S. by E.	4 p.m. (18th).	S. by E.	42	2	11 p.m. (18th)	W. by S.	12	5 p.m. (18th).	S.	42	—
	8 a.m. (19th).	S.S.W.	3 p.m. (19th).	S.W.byW.	44	10	2 a.m. (21st)	W.N.W.	42	4 p.m. (19th).	S.W.byW.	50	
			10 a.m. (20th).	W. by N.	42	7							

Observatories, October 18th–20th.	Velocity, 30–40 Miles per Hour.		Velocity Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours, the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vol.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Holyhead -	10 .a.m. (18th)	S.E. by S.	1 p.m. (18th).	S.E. by S.	50	12	11 a.m. (19th)	S.W.	25	8 p.m. (18th).	S.E. by S.	61	Lull between the gales only lasted 1 hour.
	Noon (19th).	S. by W.	2 p.m. (19th).	S.S.W.	43	11	4 a.m. (21st)	W.N.W.	40	Noon to 3 p.m. (20th).	W.	64	
			4 a.m. (20th).	S.W. by W.	51	21							
Stonyhurst -	7 p.m. (18th).	S.S.E.	—	—	—	—	2 a.m. (19th)	S.W. by W.	7	11 p.m. (18th).	S.S.E.	40	—
Alnwick Castle	11 p.m. (18th).	S. by E.	—	—	—	—	6 a.m. (19th)	S.W. by W.	7	3 a.m. (19th).	S.W.	40	—
Kew - -	11 a.m. (19th).	S.S.W.	—	—	—	—	2 p.m. (19th)	S.W. by W.	3	1 p.m. (19th).	S. by W.	36	—
Yarmouth -	10 p.m. (18th).	S.	—	—	—	—	3 a.m. (19th)	S. by W.	5	2 a.m. (19th).	S. by W.	31	—

Rain fell everywhere, very heavily on our north-west coasts, and hail in the south of Ireland, where lightning was again seen.

We cannot attempt in writing this chronicle to unravel all the complications exhibited in the curves, or to do more than give the leading features of the weather changes to which the larger and more general oscillations appear to be owing. There is not telegraphic information available sufficient to supply charts which will elucidate all the many changes which occurred on the 19th. It is, however, worthy of note that immediately after the second minimum was reached at Kew an abrupt oscillation of pressure occurred, accompanied by a very sudden and considerable fall of temperature, and a temporary shift of wind to W. in a hard squall. A similar though less marked change occurred at most of the other observatories, particularly at Falmouth, where it was almost simultaneous with a severe thunderstorm lasting about 15 minutes.

Oct. 20. The barometer had risen very rapidly at the south-western stations, and to a slight extent in the north of Scotland also. A clearly defined depression whose centre, with a reading below 29 inches, lay near Edinburgh, produced the sudden dip which is observed in the Glasgow and Stonyhurst barograms on this morning, and considerably retarded the recovery of pressure from the previous disturbances at Armagh and Aberdeen. The wind was strong and squally generally, and its circulation round the region of lowest pressure was complete. In Ireland it was north-westerly, and blew a strong gale on the southern coasts; in England westerly, blowing hardest in the west; south-westerly in Holland; and easterly in Scotland and Norway. These gales recorded followed so closely on those produced by the previous disturbances that at the south-western and southern observatories they appear almost as one disturbance, and are included in the gale table given above.

By the morning of the 21st this storm had disappeared; the barometer had risen rapidly everywhere, and the sky cleared except in the west. Some rain had fallen in most places. A brilliant aurora was seen in Ireland, Scotland, and the west of England on the night of the 20th.

Oct. 22. Pressure after having recovered from the disturbed weather of the past few days, again gave way somewhat; but on this occasion the change was greatest in the N. of Scotland, where a slight depression had shown itself by 8 a.m., Plate LIX. The winds over our islands and the neighbouring coasts, though light, circulated round the region of lowest barometer, with cloudy weather, and rain on the south-west coasts. By 2 p.m. the wind at Skudesnaes had increased to a gale from S.S.E., but the definite form of the depression was disappearing. Renewed bad weather was, however, approaching us from the westward; for the barometer at Valencia began to fall again rapidly, and the wind, backing into S., rose to a gale. This decrease of pressure and increase of wind from the S. spread rapidly along our western and southern coasts, and, as a strong southerly breeze, across to the E. of Scotland. In the north-west of France it blew very hard. Rain fell generally, very heavily in the south of Ireland.

Oct. 23. At 8 a.m. the centre of the depression lay over the W. of Scotland (Fig. 46, Plate LX.) in almost the same position as that occupied by the slight one of the previous day. The barometer in that neighbourhood had fallen nearly an inch in the 24 hours, but as the fall extended over a very large area gradients were not remarkably steep, the wind, nevertheless, after veering to W. on our S.W. coasts, blew hard. A severe thunderstorm occurred at Penzance, and rain fell generally.

Oct. 24. The centre of the storm lay over the E. of Scotland (Fig. 47, Plate LX.), the minimum reading having occurred at Glasgow and Aberdeen at about 11 p.m. on the 23rd. The progress of the disturbance was therefore slow, and as a very brisk rise of the barometer had set in at Valencia after midnight the gradient for north-westerly winds increased across Ireland and St. George's Channel to ·13 per 50 miles. The gale now became general from W. and W.N.W., and at our south-western stations it was very severe. Squally rainy weather had continued, with lightning and hail at Valencia. More than an inch of rain was recorded at Stonyhurst. The more northern parts of the country escaped the worst of the storm, although at Ardrossan the wind rose to a strong gale in the night. In Norway, however, a severe easterly storm set in, while on the southern shores of the North Sea the wind was only moderate to fresh from the southward.

Annexed are the main features of the gale in a tabular form.

Observatories. Oct. 22-24.	Velocity, 30-40 Miles per Hour.		Velocity Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	2 p.m. (22nd).	S.	4 p.m. (22nd).	S.	50	8	3 p.m. (24th)	W.	49	9 p.m. (22nd).	S.	60	Midnight 22nd to 7 p.m. 23rd, velocity varied from 29 to 41 miles from the south-westward.
			7 p.m. (23rd).	W.	45	9							
Armagh -	10 p.m. (22nd).	S.	—	—	—	—	1 a.m. (23rd)	S. by E.	3	11 p.m. (22nd).	S. by E.	34	Light wind all day.
Glasgow -	—	—	—	—	—	—	—	—	—	5 a.m. (23rd).	S.E.	32	For one hour only.
Aberdeen -	4 a.m. (23rd).	S. by E.	—	—	—	—	Noon (23rd)	S. by E.	8	7 a.m. (23rd).	S.S.E.	37	—
Sandwick -	5 a.m. (23rd).	S.E. by S.	—	—	—	—	2 p.m. (23rd)	S.E.	9	10 a.m. (23rd).	S.E. by S.	43	For one hour only.
Falmouth -	Midnt. (22nd).	S.S.W.	—	—	—	—	6 a.m. (23rd)	W. by S.	6	4 a.m. (23rd).	S.S.W.	40	—
	10 a.m. (23rd).	W. by S.	1 a.m. (24th).	W.	47	15	6 p.m. (24th)	W.	32	11 a.m. (24th).	W. by N.	52	
Holyhead -	7 p.m. (22nd).	S.S.W.	10 p.m. (22nd).	S.	49	7	3 a.m. (25th).	W.S.W.	56	Midnight (22nd).	S. by E.	56	—
			7 p.m. (23rd).	S.W. by S.	47	6							
			6 a.m. (24th).	W.	48	12							
Stonyhurst -	5 a.m. (23rd).	S.S.E.	—	—	—	—	8 a.m. (23rd)	S.	3	5 a.m. (23rd).	S.S.E.	35	—
	Noon (24th).	W. by S.	—	—	—	—	9 p.m. (24th)	W. by S.	9	2 p.m. (24th).	W. by S.	34	

At Kew and Yarmouth the velocity of 30 miles per hour was not recorded, and at Alnwick Castle it was only slightly exceeded, from the westward, on a few occasions between 10 p.m. on the 24th and 2 p.m. 25th. In the evening a most brilliant auroral display was seen in all parts of western and central Europe, and also at sea for a very great distance from the coasts of Europe.

By the morning of the 25th the disturbance lay between the Scotch and Norwegian coasts, and was less marked. At the northern observatories the barometer rose steadily, but in the Valencia barogram a slight oscillation is observed between midnight and 4 a.m., which is reproduced, with some modifications, at Falmouth at 7 a.m. and at Kew about 2 p.m. This irregularity seems to have been caused by the passage of a small depression from the westward up the English Channel, which, while it reduced the gradients for west winds over the British Islands, and even established (temporarily) light easterly breezes in the south of England, yet rendered the gradients steeper over France, so that the westerly gale continued with considerable force in that country. In the evening aurora again showed most brilliantly in all parts of the British Isles and their neighbourhood.

Oct. 26. At 8 a.m. the depression of the past few days had disappeared, and westerly winds were chiefly prevalent in the British Isles and France, with light easterly breezes in Norway. On our own coasts the wind was light to fresh, but to the westward and north-westward of the Irish coast a S.W. gale was experienced, with bright aurora in the evening, the barometer being down to 29·15; while the ship "Tenasserim," which was about 100 miles S.W. of Cape Clear, had west north-westerly squalls with lightning and rain, similar weather being reported at Valencia. Some rain fell on our W. coasts, hail fell at Falmouth, where between 6 and 10 a.m. the wind veered completely round the compass from W.N.W. to W.N.W. again. In the evening a thunderstorm with hail was noted at Markree (Sligo), and lightning was seen in London at 2 a.m. On the whole, however, the sky cleared considerably, except on the southern coasts.

Barometrical pressure continued to increase generally for the next two days. On the 27th the westerly winds continued, exceeding the velocity of 30 miles per hour at the western observatories in some parts of the day, and reaching 38 miles at Holyhead at 3 a.m., while the S.S. "European," in lat. 55° 6′, and about 250 miles W. of the Irish coast, felt a westerly gale, but with fine weather. On the 28th the wind had veered to N.W. over the British Isles, and rose to a moderate gale in the south of Ireland, but soon subsided again. At Falmouth also a velocity of 41 miles from W.N.W. was attained at 2 a.m., and 36 miles at Sandwick at 6 p.m. The weather was cloudy and showery, except on our N.E. coasts, and lightning was reported at Pembroke.

Oct. 29. A slight diminution of pressure occurred at Valencia, Plate LXI., extending subsequently to the other parts of the kingdom. The wind backed temporarily into S.W. or S. in most places, and blew strongly on the W. coast, with rain, but soon subsided. A velocity of 46 miles was reached at Valencia by 6 a.m., and 37 miles at Falmouth at 11 a.m., while at Holyhead the weather was very squally, the velocity varying from 17 to 40 miles per hour all day.

On the morning of the 31st another marked hollow is found in the barograms at the south-western and southern observatories which is much less decided in the north. It was accompanied by a great increase of wind on our south-western and southern coasts, as will be seen by the following table:

Observatories. Oct. 30-31.	VELOCITY, 30-40 Miles per Hour.		VELOCITY, Exceeding 40 Miles per Hour.				VELOCITY, Fell below 30 Miles per Hour.		Total No. of Hours, the Vel. above 30 Mls.	MAXIMUM VELOCITY.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	11 p.m. (30th).	S.W.	Midnt. (30th).	S.W.	42	2	6 a.m. (31st).	W. by S.	7	1 a.m. (31st).	S.W. by S.	43	—
Falmouth -	5 a.m. (31st).	S.W. by W.	8 a.m. (31st).	W. by S.	46	7	5 p.m. (31st).	W.N.W.	12	11 a.m. (31st).	W. by N.	54	—
Holyhead -	2 p.m. (31st).	N.W.	—	—	—	—	11 p.m. (31st).	N.N.W.	9	3 & 5 p.m. (31st).	N.W. by N.	42	—

Some rain fell, after which the barometer rose rapidly everywhere and the wind veered northwards, reaching a velocity of 33 miles an hour at Aberdeen by 11 a.m.

Nov. 1. The rise of the barometer since the morning of the 31st amounted to an inch in the extreme north of Scotland, and readings varied from about 30·4 in. at our north-western and western stations to about 30·0 in. over Holland. Temperature had fallen everywhere but in the east of England, and the south-westerly winds, so prevalent in October, gave way to a northerly current, which, though moderate in most places, blew rather strongly on our south-east coasts. The sky became clear.

Nov. 2. An anticyclone, with readings above 30·5 in., had formed over England and the North Sea by the continued increase of pressure in those regions, accompanied by a slight diminution in Ireland and Scotland. Round this the wind circulated, being light generally, but fresh from S. on our western coasts, where temperature rose and cloud increased. Fog prevailed in the south-east. In Norway rain was very prevalent, 2·6 inches having fallen at Bodö since the 1st. From this time until the 6th there was very little change. Pressure and temperature were steady, the winds light and variable, while the weather was rather cloudy and foggy. In Norway, however, a considerable fall of the barometer took place on the night of the 2nd, and a southerly gale blew on their western coast next morning. The ship "Celaeno" also, which was in lat. 45° N., long. 14° W., and steering to the south-westward, on the 2nd had a strong E.N.E. breeze, which moderated and gradually drew round to S.E. by the 3rd, with "warm gusts at times," the barometer falling slowly.

Nov. 6. Pressure had given way rapidly in Norway since the previous morning, the decrease extending to our coasts also, as shown by the barograms for this and the preceding day, Plate LXII. The region of highest pressure was in Ireland and the S.W. of England; but gradients thence to Christiansund were not steep. The wind at first backed to W. except at the south-western and French stations, but continued moderate, with a rise of temperature in Scotland, a considerable quantity of cloud, and some rain. The fall of the barometer continued all day; but on the following morning (7th) a recovery had commenced at Christiansund. The wind gradually veered to N. again. Temperature fell and was low on our north and east coasts, cloudy weather continued, and some more rain fell in the west and north. An aurora was seen in Guernsey.

Nov. 8. The rise of the barometer extended to our northern stations, where the barometer now stood highest, and readings were very uniform. Temperature fell again and became very low in the south of Scotland. Winds were light and continued to circulate round the maximum pressure. At Christiansund, however, a fresh S.S.W. breeze had set in, with rain, and at night aurora was seen in Scotland.

Nov. 9. Barometrical pressure had again fallen in Norway, and to a less extent on our coasts. In Caithness temperature rose, and while a westerly gale was blowing at Christiansund, a strong northerly breeze was reported from Thurso, and moderate westerly winds on our eastern coasts. At the south-western and French stations easterly breezes prevailed, apparently forming part of another system, (see Fig. 49, Plate LXIII.,) which is confirmed by the fact that in lat. 46° to 44° N., long. 15° to 16° W., the ship "Inverness" was in a strong N.W. gale, with the barometer down to 29·52. On the coast of Portugal also fresh W.N.W. breezes were reported by the "British

American." Rain had fallen, except in the N.W. and east, where the weather was foggy, and squalls, with sleet, commenced in Scotland. Aurora was seen at Stonyhurst in the evening of the 9th.

Nov. 10. The depression in Norway had apparently advanced south-eastwards, Fig. 50, and (as far as can be seen from the scanty information available for this period) lay over the south of Sweden and the Baltic, while that to the south-westward of these islands had travelled eastwards over France. A slight recovery of the barometer had therefore set in at Valencia and Falmouth, but elsewhere the fall had continued. The northerly wind became general, blowing strongly in Scotland, very freshly in the west of the British Isles, and drawing into W. in the south-west of France. Several squalls of snow, sleet, and hail were reported from all our western and northern stations; and while temperature fell in Norway and on our southern coasts, it actually rose again in the north of Scotland, where it was now highest. The minimum pressure occurred at Aberdeen at 7 a.m., and by the afternoon a slight recovery was general, except in the extreme north of Scotland, and the wind moderated. At Alnwick a thunderstorm occurred at night.

Nov. 11. The barometer had continued to fall at the south-eastern stations, which with a slight rise in the north made gradients steep for northerly winds. Apparently a large depression lay over the north of Germany (*see* Fig. 51, Plate LXIII.). The northerly wind increased to a stiff gale over the west and north of the British Isles, and extended over France, where temperature fell rapidly. The squalls of hail and sleet were heavy, and at Roche's Point frequent lightning had been seen in the night. The following table gives the main features of the gale as felt at the various anemometer stations:

Observatories. Nov. 9-12.	VELOCITY, 30-40 Miles per Hour.		VELOCITY, Exceeding 40 Miles per Hour.				VELOCITY Fell below 30 Miles per Hour.		Total No. of Hours, the Vel. above 30 Mls.	MAXIMUM VELOCITY.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia	2 p.m. (9th).	N.E.	—	—	—	—	10 p.m. (9th).	N.N.E.	8	2 p.m. (9th).	N.E.	35	Wind again freshened to 30 miles from N. at 5 and 7 p.m. 10th.
Sandwick	5 a.m. (9th).	N. by W.	4 a.m. (10th).	N.	42	20	8 p.m. (11th).	N. by E.	59	4 p.m. (10th).	N. by E.	47	Occasional lulls on morning of 9th.
Falmouth	4 a.m. (11th). Noon. (11th).	N.W. N.W. by W.	—	—	—	—	7 a.m. (11th). 5 p.m. (11th).	N. N. W.	8	4 a.m. (11th).	N.W.	39	—
Holyhead	5 p.m. (9th).	N. by E.	9 p.m. (9th). 3 p.m. (10th).	N.N.E. N. by E.	48	46	Noon (12th).	N.W.	67	7 p.m. (10th).	N.	63	Wind lulled to below 40 miles from 9 a.m. to 3 p.m. on the 10th.
Yarmouth	—	—	—	—	—	—	—	—	—	—	—	—	Wind freshened from northward on evening of 10th, the velocity exceeding 30 miles occasionally.

At Hawsker (near Whitby) the velocity was 43 miles per hour at 4 p.m., and 787 miles of wind were registered between the mornings of the 11th and 12th. Over the Atlantic, for a considerable distance to the westward and S.W. of Ireland, similar weather prevailed, the squalls being exceedingly heavy. Pressure now gave way in the west and north, and by 2 p.m. the wind had begun to moderate.

Nov. 12. Barometrical readings were lower everywhere than on the previous day (*see* Fig. 52, Plate LXIV.), especially in the N. and N.W. A depression still lay over Germany, but its influence to the westward was much reduced. In the south of Norway, however, a heavy N.N.E. gale was still blowing, and a moderate N.N.W. gale at Helder, with a very heavy S.W. gale at Hamburg. In the United Kingdom the wind varied from N.E. in the north of Scotland to north on the Irish coasts, and N.W. in England. The squalls and sleet ceased, rain fell in the south-west of England, but elsewhere the sky cleared. H.M.S. "Phœbe," however, in lat. 49° N., long. 16° to 11° W. (steering eastward), had heavy northerly squalls with large flat hailstones and lightning until 10 a.m. on the 13th, when the wind moderated and backed to W.N.W.

Nov. 13. A slight recovery of pressure at our south-western stations and a further decrease over Scandinavia produced a new depression whose centre was apparently nearly over the south of Sweden. A strong easterly gale set in at Christiansund, and the S.W. gale continued at Hamburg, but in the British Isles very little resulted beyond the backing of the wind to N.W. and its freshening at some stations, especially at Holyhead, where it blew with the force of a slight gale for two hours from 10 a.m. Rain fell very heavily at Scarborough. Hail showers continued at Valencia, and some snow fell in the south of England. Pressure now gave way again in the west and north of the British Isles, and in the night the wind backed to S.W. on our N.W. coasts and freshened. At Holyhead a velocity of 42 miles from W.S.W. was registered at 2 a.m. on the 14th.

Nov. 14. Readings were as low as 29 inches in Scotland, whence they increased to 29·8 in the south-west of France. Light to moderate westerly breezes prevailed in the north of Great Britain, but a fresh N.W. wind blew in the south of Ireland, moderate westerly in the English Channel, but strong and squally south-westerly breezes in the Straits of Dover and on the Belgian and Dutch coasts. In Norway the wind was variable. Temperature had risen in the south and fallen in the west and north, and the weather had been showery except in the north-east. A thunderstorm occurred at Ardrossan, and hail was reported from Valencia.

Nov. 15. Pressure had been very unsteady on our southern coasts, apparently owing to some local disturbances, but by 8 a.m. a definite though slight depression lay over the east of Scotland, round which the wind circulated. It was fresh on our N.W. coasts, and reached a velocity of 48 miles an hour from N.W. at Holyhead in the afternoon. In the English Channel (off Plymouth) and the Downs the ships "Flying Venus" and "Mervyn" experienced squally N.W. breezes with sleet and snow. Temperature fell and was low in the east and south of England, while in Ireland and Scotland it rose. Lightning was seen at Kew in the evening.

With the exception of some unsteadiness of the barometer at Valencia on the 16th, and in Scotland on the 17th, the increase of pressure continued until the 18th, with north-westerly and northerly winds in these islands, which were in general moderate to fresh, but blew 40 miles an hour at Sandwick and Holyhead at times on the 17th, and easterly breezes in Norway. Cloudy showery weather prevailed with snow and hail in some places; but temperature showed little change. At about 10 a.m. on the 18th, however, pressure gave way suddenly over the United Kingdom, chiefly in the north-west; while temperature increased, and the wind shifted to S. at Valencia, and subsequently at the other observatories on our western coasts. Rain fell heavily in the west, and an aurora was seen at Aberdeen at evening. On this day the "Scotia," Capt. C. W. Kennedy, in latitude 51° 30′ N., longitude 14° to 12° 30′ W., experienced a fresh S.S.W. gale for two hours and a half, with rain, which then moderated and veered very quickly to W.S.W., W.N.W., and N.N.W., where the weather cleared up.

Nov. 19. At 8 a.m. the barometer had fallen half an inch in Ireland and less elsewhere. Pressure was on the whole lowest in the north-west, but there was apparently a slight local depression lying over the south-east of Ireland, where the barometer had fallen 0·7 inch. The wind which had blown a stiff gale from the southward in the south of Ireland and St. George's Channel in the night, and still blew a moderate breeze from the same quarter in most places, had already veered to N. again at Valencia and Roche's Point with squalls and showers. The following table gives the usual details of the wind as shown by the anemometers, from which the limited range of the disturbance is evident:

Observatories. Nov. 18-19.	Velocity, 30-40 Miles per Hour.		Velocity, Exceeding 40 Miles per Hour.				Velocity, Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	4 p.m. (18th).	S.	6 p.m. (18th).	S. by W.	45	5	11 p.m. (18th)	S.W. by S.	7	10 p.m. (18th).	S.	49	—
Sandwick -	9 a.m. (19th).	S. by E.	—	—	—	—	5 p.m. (19th).	S. by W.	8	10 a.m. to 2 p.m. (19th).	S. by E.	38	—
Falmouth -	5 a.m. (19th).	S.	—	—	—	—	1 p.m. (19th).	N.W.	8	5, 6, and 11 a.m. (19th).	S.	33	—
Holyhead -	11 p.m. (18th).	S. by E.	Midnt. (18th).	S. by E.	46	17	7 p.m. (19th).	W.	20	3 p.m. (19th).	S.E. by S.	53	—

It seems in all respects similar to that experienced by the "Scotia" on the 18th. Temperature had risen in the south-west, west, and north, but very sudden oscillations occurred at Falmouth at 7 a.m. and 2 p.m. Cloudy weather was general. Bright aurora was seen in Scotland and Ireland at night. As this depression passed eastwards, the wind rose to a gale from S.E. and E.S.E. at Holyhead, but by the next morning all signs of the disturbance had disappeared. On the 20th the relative distribution of pressure differed little from that of the previous day. South-westerly winds became general, blowing freshly in the west, and temperature rose in all parts of England.

Nov. 21. A temporary rise of the barometer had occurred at the northern and south-eastern stations, which, with a slight further fall in the north-west, produced a shallow depression over the N.W. coasts, on the eastern side of which gradients were steepest. The wind veered to N.N.W. in the south of Ireland, but blew fresh to strong from W. in the S.W. of England, and moderately from S. on our eastern coasts. As the day advanced the disturbance extended eastwards, and the wind rose to a fresh gale from S.S.W. and S.S.E. on the eastern and northern coasts, and a S.E. gale set in on the Norwegian coast at night. The weather was rainy, and warmer in the east and north than of late.

Nov. 22. The recovery from yesterday's depression had been very slight, and a new fall of the barometer had occurred on our western coasts, accompanied by the backing of the wind to S. and S.E. The new disturbance was insignificant, but quickly diffused itself over the United Kingdom, producing squally southerly, south-westerly, and westerly winds, with rain. At Falmouth the velocity rose to 46 miles an hour, from S.W. by S., at 11 a.m., and exceeded 40 miles an hour for 8 hours from that time, but nothing above 37 miles was recorded anywhere else, gradients being moderate. In Norway the wind was easterly. The progress of the disturbance, in a north-easterly direction, was tardy, but the central area was of large extent. At about 8.15 p.m. a sudden oscillation of pressure, with a fall of temperature and temporary veering of the wind in a lull, occurred at Falmouth which is shown nowhere else.

Fig. 53, Plate LXVI., gives the position of the depression at 8 a.m. on the 23rd, when the barometer was rising again fast in the south of Ireland, with moderating north-westerly winds. This recovery soon extended to our coasts, but by noon the rise had ceased at Valencia, and a new disturbance was advancing towards Ireland.

Nov. 24. The centre of the new disturbance was a little to the westward of the Irish coast (*see* Fig. 54, Plate LXVI.), but its influence was manifest over the whole of England and the north of France, while on the N. and E. shores of the North Sea the barometer had risen about 0·35 in. Like its predecessor it was of considerable superficial extent, but shallow, except on its S.E. side. Very little wind was felt in Scotland, though in the English and Irish Channels, and on the Dutch coast, a moderate S.W. gale, with rain, was general, as will be seen by the following table:

Observatories. Nov. 23-24.	Velocity, 30-40 Miles per Hour.		Velocity, Exceeding 40 Miles per Hour.				Velocity, Fell below 30 Miles per Hour.		Total No. of Hours, the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Com-menced.	Direction of Wind.	Com-menced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	6 p.m. (23rd).	S.E. by E.	11 p.m. (23rd).	S.S.W.	41	3	10 a.m.(24th).	S.S.W.	12	11 p.m. (23rd).	S.S.W.	42	Lull to 15 miles between 4 a.m. and 7 a.m. 24th.
Falmouth -	8 p.m. (23rd).	S.	10 p.m. (23rd).	S. by W.	44	15	8 p.m. (24th)	S. by W.	24	11 a.m. (24th).	S.	50	—
Holyhead -	10 p.m. (23rd)	S.S.E.	—	—	—	—	1 a.m. (24th).	S.E.	3	Mdngt. (23rd).	S.E.	38	Also blew S. 30 miles at 8 a.m. and 32 miles at 11 a.m. on 24th.
	6 p.m. (24th).	S.S.E.					11 p.m. (24th).	S.	5	9 p.m. (24th).	S.S.E.	37	
Kew -	3 a.m. (24th).	S. by W.	—	—	—	—	3 p.m. (24th).	S.	12	9 a.m. (24th).	S. by W.	40	For one hour only.

At Yarmouth a velocity of 30 miles was slightly exceeded from W.S.W and W. on the mornings of the 23rd and 24th. In Norway a S.E. gale set in on the 25th, which subsequently veered to S.S.W. as the depression travelled northwards.

This storm closed, for a time, the period of squally disturbed weather which had recently prevailed over these islands. A rapid rise of the barometer set in everywhere, with comparatively light winds and fine weather.

By 8 a.m. on the 27th an anticyclone lay over the E. and S.E. of England, round which the wind circulated, with weather which was generally fine but hazy. A thunderstorm occurred at Pembroke. Over the Atlantic, between long. 11° and 15° W., and in lat. 50° to 51° N., strong southerly winds were felt, with rain; and as the vessels reporting it steered westwards their barometers fell.

Nov. 28. The continued increase of pressure over the North Sea, accompanied by a very slight decrease in the west, made gradients for southerly winds steep over Ireland. In consequence of this the wind rose to a fresh gale on our south-western coasts for a short time, as shown in the following table.

Observatories. Nov. 30-Dec. 2.	Velocity, 30-40 Miles per Hour.		Velocity Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Com-menced.	Direction of Wind.	Com-menced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	11 a.m. (30th).	E.S.E.	11 p.m. (30th).	E.S.E.	42	4	7 a.m. (Dec. 1st).	E.	15	1 a.m. (Dec. 1).	S.E. by E.	45	Lull to 22 miles from 2 till 6 p.m. 30th.
Falmouth -	11 a.m. (30th).	E. by N.	10 a.m. (Dec. 1st.)	E.S.E.	42	2	Noon (Dec. 2nd).	E.S.E.	48	11 a.m. (Dec. 1).	E. by S.	44	—
Yarmouth -	—	—	—	—	—	—	—	—	—	—	—	—	Wind freshened to 30 miles an hour from E. by N. at 8 p.m. on 30th.
Kew -	3 p.m. (30th).	E. by N.	—	—	—	—	8 p.m. (30th).	E. by S.	5	3 p.m. (30th).	E. by N.	34	—

This soon subsided as the western readings recovered.

In Norway the barometer still rose, and the month closed with an anticyclone which lay over the south of Scandinavia, and across the North Sea to the north-east of Great Britain. Moderate easterly winds blew along the southern coasts, gradually drawing round to S.E. in the north-west and north. Fog was very prevalent until the 27th, and the sky was cloudy, with slight rain at some of the southern stations.

Dec. 1. The wind had increased considerably on our south-west and south-east coasts, blowing a fresh to strong S.E. breeze at Valencia and on the Cornish coast, and reaching a velocity of 36 miles from E. at Yarmouth. The S.S. "Idaho," passing a short distance to the southward of the Irish coast, and steaming to the westward, had a fresh S.E. gale, which gradually veered to S. by the following afternoon, when she was in lat. 51° 25′ N., long. 17° 39′ W.

On the 2nd a rather rapid decrease of pressure had taken place over Sweden, affecting, but in a much less degree, our own north-eastern readings during the night. By this means an anticyclone was formed over Great Britain and the north of Ireland, in which the highest readings were rather above 30·6 ins. The winds veered to W. or S.W. at our north-eastern stations, but were more northerly in the S. of Norway, while the easterly breezes on the southern coasts moderated considerably. Temperature fell and was low. The weather was very cloudy. At about noon the fall of the barometer extended to our east coast, but was not rapid.

Dec. 3. The lowest readings were found to the eastward and south-eastward of this country, apparently over Germany, the region of maximum pressure lying to the north-westward of us. At Christiansund the barometer had again fallen briskly. Gradients were not very steep. The wind veered to N. on our north and east coasts, and at night freshened in several places, attaining a velocity of 48 miles from N.N.E. at Holyhead by 7 a.m., on the 4th, and 45 miles from E. by N. at Yarmouth by 5 a.m. In the Channel, and on our S.W. coasts, it was more easterly. Temperature fell somewhat over France, Ireland, and the S.W. of England, but rose several degrees in other parts, and some rain fell during the day. Clouds were still heavy and in large quantity. The barometer continued to fall at the English observatories until the morning of the 4th, when a recovery set in which was most marked at Kew, but continued only till midnight. The wind became generally north-easterly, the barque "Emulation," not far from Scilly, experiencing a gale from that quarter. At Glasgow a rather sudden fall of temperature occurred about 1 a.m, on the 4th, from which an equally brisk recovery took place a little before noon. The weather was much warmer generally, except in the east of England and north-east of France. In Scotland it was showery, and some rain and snow had fallen in the S. of England.

Dec. 5. The barometer again began to fall generally, but the change was not serious till after noon. The weather had, however, become cold in the S.W. of England and west of France, and temperature was falling in Scotland. This change of temperature seems to have set in at Kew at about 4.30 a.m. on the 4th, and at Falmouth immediately after noon, simultaneously with a veering of the wind from N. to E. At Stonyhurst (where hail was reported) a somewhat similar decrease occurred after 1.30 p.m., but the cold was not so great, and the wind veered round from N. to E., S., and S.W. In Ireland the weather was finer. After noon the decrease of pressure became more rapid, more particularly in the N. and E.

Dec. 6. The barometer had fallen very considerably throughout the British Isles and their neighbourhood. A depression had apparently formed over Scandinavia, in consequence of which the wind became northerly on all our coasts. In the morning it was light, but increased in the Irish Channel and N.E. of England at evening. Temperature again fell, except in the S. of England, where it recovered from the cold noticed on the 5th. Some rain had fallen almost everywhere, snow in London, and fog was reported in the Channel. The barque "Emulation" was now about 120 miles west of Corunna, with strong squally northerly breezes and rain; similar weather (but with rather lower temperature) being experienced by the S.S. "Moravian," off the N.W. coast of Ireland. By 2 p.m. a temporary recovery of pressure had set in at Thurso.

Dec. 7. The depression of yesterday had travelled southwards, and was apparently over Denmark; the S.W. wind at Hamburg showing that the centre was yet northward of that city. The barometer had risen two tenths at Christiansund. Gradients were steepest over the northern and western parts of the North Sea. In Norway the northerly wind rose to a stiff gale, and a considerable increase of wind had occurred in many parts of the British Isles, as will be seen from the following table.

Observatories. Dec. 6–8, 1870.	VELOCITY, 30–40 Miles per Hour.		VELOCITY Exceeding 40 Miles per Hour.				VELOCITY Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 mls.	MAXIMUM VELOCITY.			Remarks.
	Com-menced.	Direction of Wind.	Com-menced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Glasgow -	Noon (6th).	N.	—	—	—	—	7 p.m. (6th).	N. by E.	7	Noon (6th).	N.	38	—
Sandwick -	2 p.m. (6th).	N.	—	—	—	—	9 p.m. (7th).	N.E. by E.	31	3 p.m. (6th).	N.	41	For one hour only.
Holyhead -	3 a.m. (6th).	N.W.	8 a.m. (6th).	N.	45	33	3 a.m. (8th).	N. by E.	48	5 p.m. (6th).	N. by E.	51	—

At Scarborough and Shields also an "extreme" force of 7 (by Beaufort scale) was reported. At Falmouth and Alnwick Castle the velocity of 30 miles from N.N.W. was exceeded in the evening. The schooner "Traveller," about 200 miles S. of Cape Clear, had a stiff northerly gale in the evening. The weather continued unsettled, with rain in most places, and snow and hail on our North Sea coasts, where the sea was rough.

Pressure now rose very briskly in Norway and to a less extent in Holland, but continued to fall over these islands. Thus, on the morning of the 8th, a new but much smaller depression had formed over the North Sea very near to Shields, but while gradients on its northern side were steep, they were very slight to the southward and south-eastward of it. Conditions were, in fact, somewhat complicated; for while a north-easterly gale blew in Norway, and moderate to fresh northerly winds on all but the north-eastern coast of England, a slight westerly breeze was reported from Shields and Scarborough, and a S.E. wind from Helder. The depression was therefore purely local in its influence, and the more general direction of the wind was north-easterly or northerly. Snow showers had occurred in most parts of the country, and thunderstorms in St. George's Channel.

Dec. 9. The barometer had again risen in the north but fallen slightly in the south-west; but readings were generally lowest over Belgium and the Netherlands, and highest in Scotland and Norway, while the local depression noticed yesterday had travelled to the south-westward and was over central England (Fig. 56, Plate LXIX.) Gradients for easterly winds became very steep on our north-east coast, that from Aberdeen to Scarborough being 9. A fresh to strong easterly gale had set in over that part of the country and on the N.E. coast of Ireland, with heavy rain, some hail, and a high sea. At Aberdeen the velocity exceeded 30 miles per hour for 27 hours, averaged 47 miles for 13 hours from 2 a.m., and reached a maximum of 51 miles at 1 p.m., while at Sandwick, Glasgow, Alnwick Castle, and Yarmouth it did not rise to 40 miles, though 37 and 35 miles were recorded for a short time. The principal violence of the gale was felt in the neighbourhood of the Tyne, Whitby, and Scarborough, where force 10 was reported by three careful observers; but there is no anemometer to refer to. At the same time light northerly winds prevailed in the Irish Channel, drawing round to N.W. and W. in the south of England. Temperature fell still lower in the west and south-west, but the sky became clear and the weather fine on all our southern coasts.

Dec. 10. Barometrical pressure having recovered considerably over the British Islands, especially on the south-east coasts, and fallen in Norway, gradients were slight, and the wind moderated, except in the Skager Rack, with very little change as to its direction. In the west of Norway, however, it veered towards S. Temperature fell somewhat in the north, but rose in other places. Rain fell in the north-west and east of our islands, and the sky was overcast generally. The decrease of pressure now extended from Norway to the British Islands, reaching the east coast by the afternoon, while the western pressures began to give way at night. This western decrease appears to have arisen from causes different from that in the east, as will be seen in the sequel.

Dec. 11. Barometrical readings showed considerable reduction everywhere, especially in the north. A band of comparatively high readings lay along the E. coast of Great

Britain, whence pressure decreased to 29·7 at Christiansund, and to 29·6 ins. in the S. of Ireland. Light variable northerly airs prevailed over the North Sea, and temperature fell very much on our north-east coast; but on our south-west coasts, where the fall had become rapid, the wind rose to a strong breeze from E., S.E., and S., reaching a velocity of 38 miles at Valencia and Falmouth, with heavy rain, which amounted to 1·58 in. at Roche's Point. During the day a depression advanced on our western coasts, and next morning its centre lay over Ireland.

Dec. 12. The new disturbance was of great extent, so that over Ireland readings at 8 a.m. were very uniform (*see* Fig. 57, Plate LXX.), but across the east of England and over the North Sea gradients were steep. A S.E. to S.W. gale set in over St. George's Channel and certain parts of the North Sea, reaching a velocity of 50 miles an hour at Yarmouth; but though, so far as direction is concerned, the cyclonic circulation of the wind was nearly complete, yet the force as a rule was not great. Rain had fallen in the W. and S., and became general as the day advanced. The barometer continued to fall on nearly all coasts until night, when a recovery set in.

Dec. 13. The diminution of pressure had continued on the northern and eastern shores of the North Sea, but had been succeeded by a brisk recovery on our own coasts. Pressure was on the whole lowest in the north-west, and highest in the south-east; and apparently the depression of yesterday lay between Norway and the north-east of Great Britain. Readings were, however, very uniform in the British Islands. Strong S.W. winds were reported from the S.E. coasts and Helder, easterly breezes from Norway, and light northerly and westerly winds on our own north and east coasts. At our other stations variable airs prevailed, and for France information is still wanting. Temperature rose except in the S. of Ireland, the change being very rapid in the extreme N. of Scotland, where snow had given place to rain, while rain had fallen everywhere else. On this day Mr. W. Greenwood, in the ship " Assaye," in 47° 47′ N. and 12° 45′ W., reports the barometer down to 28·8 at noon, the wind being at that time calm, preceded and followed by moderate to fresh south-westerly breezes, with rain. Shortly after 9 a.m. a fresh fall of the barometer commenced in the S. of Ireland, becoming rapid in the afternoon, and extending to all parts of our islands by midnight.

By 8 a.m., 14th, a new disturbance had advanced on us from the south-westward, and its centre lay over the southern and central parts of Ireland (*see* Fig. 58, Plate LXX.). Gradients were steep in almost all directions, so that strong winds or gales became very general, circulating cyclonically round the depression. The minimum barometrical readings for the month were recorded at all the observatories during the day. The thermometer had risen quickly, except in the north of Scotland. The greatest force of the gale appears to have been felt from the southward and south-westward, a velocity of 63 miles from the latter direction being felt on the coast of Northumberland, and 54 miles at Swansea.

Observatories, Dec. 14-16.	Velocity, 30-40 Miles per Hour.		Velocity, Exceeding 40 Miles per Hour.				Velocity Fell below 30 Miles per Hour.		Total No. of Hours, the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	Noon (14th).	S.W. by S.	—	—	—	—	3 a.m. (15th)	S.W.	15	7 p.m. (14th).	S.W.	37	—
Armagh -	4 p.m. (14th).	S.W.	—	—	—	—	4 a.m. (15th)	S.W.	12	1 & 3 a.m. (15th).	S.W.	32	—
Glasgow -	9 p.m. (14th).	S.W. by S.	Midnt. (14th).	S.W. by S.	43	4	8 a.m. (15th)	W.S.W.	11	4 a.m. (15th).	S.W. by S.	47	Wind had freshened to 31 miles from E.N.E. at 9 a.m., 14th, to 34 miles from E.N.E. at 11 a.m., and to 30 miles from N.E. by E. at noon, 14th.
Aberdeen -	11 a.m. (14th).	S.E. by E.	—	—	—	—	5 p.m. (14th)	S.E.	6	4 p.m. (14th).	S.E.	34	Freshened to 30 miles from S.W. at 11 p.m., 14th, and at 2 a.m., 15th.
Sandwick -	6 p.m. (14th).	E. by S.	—	—	—	—	Mid. (14th)	E. by N.	6 } 32	10 a.m. (15th).	W.N.W.	48	Wind veered to W.N.W. early on the morning of 15th.
	8 a.m. (15th).	W.N.W.	10 a.m. (15th).	W.N.W.	44	10	10 a.m. (16th)	N.W. by W	26				
Falmouth -	1 a.m. (14th).	S.S.W.	6 a.m. (14th).	S. by W.	41	3	3 p.m. (14th)	S.W. by W.	14	7 a.m. (14th).	S.S.W.	44	—
Holyhead -	2 a.m. (14th).	E.N.E.	11 a.m. (14th).	S. by E.	43	11	9 a.m. (15th)	S.W. by S.	31	2 p.m. (14th).	S.S.W.	45	Veered to S.S.W. on morning of 14th.
Stonyhurst -	—	—	—	—	—	—	—	—	—	—	—	—	Wind freshened to 30 miles from S. by W. at 1 p.m., 12th, to 30 miles from S.W. by W. at 3 p.m., 12th, and to 31 miles from S.W. by W. at 9 p.m., 12th.
Alnwick Castle	6 p.m. (14th).	S.W. by W.	10 p.m. (14th).	S.W.	48	9	1 p.m. (15th)	W.	19	8 a.m. (15th).	S.W.	63	—
Kew - -	10 a.m. (14th).	S.S.W.	—	—	—	—	2 p.m. (14th)	S.W. by S.	4	Noon (14th).	S.W. by S.	33	—
Yarmouth -	—	—	—	—	—	—	—	—	—	—	—	—	Wind freshened to 30 miles from S.E. at 5 a.m., 14th.

Rain fell generally, heavily on our S.W. coasts, and at night a bright aurora was seen at Stonyhurst.

The gale then advanced towards N.N.E., so that by the morning of the 15th its centre was apparently near the Shetland Islands, and at the south-western stations the barometer had risen six or seven tenths of an inch. At Sandwick, as will be seen from the table, the easterly winds had fallen light before midnight, between 2 and 3 a.m. the vane shifted suddenly, after a dead calm, from E. by N. to S.W. A somewhat similar phenomenon is noticeable at Armagh at noon on the 14th. Temperature fell at all but the northern stations, and the wind subsided on our western and southern coasts. In the afternoon (15th) it rose to a S.S.E. gale at Skudesnaes. The recovery of the barometric column, as this disturbance passed off, was regular and rapid at the south-western observatories, but in the north it was interrupted by some additional disturbances which produced a second oscillation at Aberdeen, Glasgow, and Armagh. The cause of this interference is not clearly shown by the charts compiled from the Telegraphic Reports, and its elucidation would require greater minuteness of investigation than it is the purpose for these pages to contain. The rain had been heaviest on the northern coasts, and at night an aurora was seen at Sandwick. In the south the weather was temporarily finer.

Dec. 16. The barometer had continued to rise on the southern coasts, while in the north the recovery had been very rapid, and had extended in some degree to Norway. A band of high pressure—its maximum readings slightly exceeding 29·8 ins.—lay from S.E. to N.W. across England, its southern extremity being ill-defined from the absence of continental information. At the same time a shallow local depression had formed in the south of Ireland and across St. George's Channel. A fresh southerly wind blew at Christiansund, while in Scotland and the south of Norway the wind was westerly, and, though moderate generally, reached a velocity of 44 miles at Sandwick in the evening. At the south-western stations, on the contrary, the wind, influenced by the local depression, veered to the eastward and rose to a velocity of 46 miles from N.E. by E. Rain and fog were reported in the south parts of England and Ireland, and in the north of Scotland a considerable amount of snow fell. Elsewhere the weather was fine. Lightning occurred at Valencia in the evening, and aurora was seen at Thurso.

Dec. 17. The depression in the south-west had disappeared, and at all stations the barometer stood higher than on the 16th; the highest readings being at the western stations. A slight local disturbance is observable in Scotland during the day, where the wind, after backing to S., veered again to W., and freshened on all our northern coasts. The greatest velocities reached were 43 miles from N.W. at Sandwick at 3 p.m., 32 miles from S.W. at Glasgow at 6 a.m., and 34 miles from W.S.W. at Alnwick Castle at 7 a.m. At the English and Irish observatories the change is not so clearly shown, but the barometer rose very unsteadily, and at Valencia, Armagh, and Stonyhurst temperature rose rapidly. On referring to Plate LXXI,, it will be seen that at Valencia the temperature changed very suddenly and peculiarly, oscillating much during the day. Brilliant aurora was seen in Ireland, Wales, and Scotland at night; and shortly before midnight barometrical pressure began to give way again in the west and north, the decrease extending to Kew next morning.

Dec. 18. The fall of the barometer just mentioned had been greatest in Scotland, but had not reached Norway—where the recovery of the preceding day continued—and rather fresh westerly winds had set in on our western coasts, with southerly breezes in the north of Scotland. Although temperature had risen rapidly on the coasts of Ireland and the W. of Great Britain, the rise had not extended over this country to the eastward at 8 a.m., at which time the distribution of temperature was very interesting On the Irish coasts, over the Irish Sea and the North Channel, the change since the previous morning amounted to 10° or 12°, with a slight backing of the wind to W.S.W.

At Glasgow, however, there was still an easterly air, and it was not until 9·30 a.m. that, with a shift of wind to W.S.W., the thermometer rose about 15° almost instantaneously. At Aberdeen the change occurred later in the day, was much more gradual, and very irregular; but by a little after midnight the thermometer stood between 45° and 51° in all parts of the country. Fresh westerly winds gradually extended to all our coasts, attaining a velocity of 43 miles an hour at Falmouth and 48 miles at Alnwick Castle in the evening, and exceeding 30 miles at Valencia, Glasgow, Sandwick, Stonyhurst, and Yarmouth. Rain had fallen generally, chiefly in the N. and N.W., the fall exceeding an inch at Stonyhurst.

Dec. 19. The barometer was lower throughout the British Isles than on the previous day, especially on our southern coasts, but had again risen in Norway. The lowest readings were still in Scotland, but the relative distribution of pressure over north-western Europe was complicated, so that it cannot be described accurately without information from over the surface of the North Sea. An anticyclone was apparently forming over northern Europe, and extending itself rapidly to the westward and south-westward. The easterly wind had strengthened materially in Norway, with very cold weather, while in Scotland and Ireland the westerly wind fell light, but was yet fresh in England. At Leith temperature had risen 16° since the previous morning, and was 31° higher than at Oxö (south of Norway), but the sudden fall of the thermometer at Aberdeen shortly after 4 a.m. (*see* Plate LXXI.) seems to indicate that the decreased temperature in Norway was beginning to affect the east coast of Scotland. During the day heavy rain fell on our N.W. coasts—again exceeding an inch at Stonyhurst—and snow at our extreme northern stations. The decrease of pressure continued till the afternoon at our western and northern stations, and till midnight at Kew, when the barometer began to recover.

Dec. 20. At 8 a.m. the barometer had continued to rise briskly in Norway, though in the south of these islands readings were from two to three tenths lower than on the morning of the 19th. Temperature had again diminished in Norway, being as low as 10° at Oxö, and in the British Islands also the thermometer had begun to fall generally. The easterly breeze remained strong on the northern and eastern shores of the North Sea, blowing a hard gale at Oxö; and though moderate in these islands, the wind veered more towards N., except on the S.W. coasts, where it freshened from the west-north-westward. In the north of Scotland, however, some further disturbance produced a stiff breeze from S.E., and kept the temperature up. In the afternoon this disturbance increased and extended down our N.E. coast. A slight thunderstorm had occurred at Penzance, and showers of snow and hail began to fall in the eastern and western parts of the United Kingdom.

Dec. 21. A very considerable change had taken place. The rise of the barometer had been rapid in the north, while on our southern coast it was slight, and in the S.W.

of England the mercury had fallen a little. A shallow depression had thus formed over the south-west of England (Fig. 59, Plate LXXI.), but gradients were rather steep over the N. of England. The wind drew into E. on our N.W. coasts and S.E. at the north-eastern stations, and rose to a stiff gale during the day. In Scotland the wind had subsided after blowing strongly, and in the W. of Ireland it was moderate, but drew into N. in St. George's Channel, round the low pressure. Temperature rose slightly in Norway, but was still very low, while throughout the British Isles it fell fast, and a sharp frost prevailed over the northern and eastern parts of the country. Snow or hail had been general, except in the Channel. In the north the fall was heavy. The following table gives the chief details of the wind in this gale.

Observatories. Dec. 20-22.	Velocity. 30-40 Miles per Hour.		Velocity. Exceeding 40 Miles per Hour.				Velocity. Fell below 30 Miles per Hour.		Total No. of Hours the Vel. above 30 Mls.	Maximum Velocity.			Remarks.
	Commenced.	Direction of Wind.	Commenced.	Direction of Wind.	Mean Vel.	Duration in Hours.	Ended.	Direction of Wind.		Hour.	Direction of Wind.	Velocity.	
Valencia -	9 p.m. (21st).	E.	Midnt. (21st).	E. by S.	41	5	2 p.m. (22nd)	E	17	10 a.m. (22nd).	E.	43	—
Aberdeen -	6 a.m. (20th).	S.E.	8 a.m. (20th).	S.E. by E.	45	12	3 p.m. (21st)	E.	33	2 p.m. & 3 p.m. (20th).	S.E.	49	—
Sandwick -	6 a.m. (20th).	S.E.	—	—	—	—	3 a.m. (21st)	S.E. by E.	21	2 p.m. (20th).	S.E. by E.	39	—
Falmouth -	5 p.m. (21st).	E.N.E.	5 a.m. (22nd).	E.N.E.	42	2	8 p.m. (22nd)	N.E. by E.	27	5 a.m. (22nd).	E.N.E.	42	—
Holyhead -	7 a.m. (21st).	E. by N.	—	—	—	—	10 p.m. (21st)	E. by S.	15	10 a.m. (21st).	E. by N.	41	This velocity was only reached for one hour.
Alnwick Castle	6 p.m. (20th).	S.E. by E.	—	—	—	--	3 a.m. (21st)	S.E. by E.	9	1 a.m. & 2 a.m. (21st).	E.S.E.	34	—
Kew - -	6 a.m. (21st).	E.N.E.	—	—	—	—	11 a.m. (21st)	E.N.E.	5	10 a.m. (21st).	E.N.E.	33	—
Yarmouth -	1 p.m. (20th).	E.	4 p.m. (20th).	E.	44	25	9 a.m. (22nd)	E.	44	2 a.m. (21st).	E.	50	Velocity again increased to 34 miles from E.N.E. for a short time, at 8 p.m., 22nd.

In the afternoon the easterly wind extended as a fresh breeze down the English Channel.

Dec. 22. Barometrical readings continued to increase, and the easterly wind was prevalent throughout England and Ireland, still blowing a fresh gale on our S.W. coasts, and a fresh breeze elsewhere. In Norway the barometer had begun to fall fast, and the southern portion of an anticyclone thus formed over the north of Scotland. The wind consequently backed towards N. on the southern coasts of Norway and the east of Scotland, and fell light, and at Skudesnaes and Oxö the sky cleared. At Christiansund the wind shifted to S.W., and apparently a depression passed over the more northern parts of Scandinavia in the succeeding 24 hours. By 8 p.m. the decrease of pressure had reached Aberdeen, accompanied by a rapid fall of temperature (Plate LXXII), and the following morning it extended to the east of England.

Dec. 23. The reduction of pressure at the northern and eastern stations had been continued, and the fall of temperature noticed yesterday was succeeded by a sudden rise again in Scotland and Norway. At 8 a.m. a region of comparatively high pressure lay over England and the east of Ireland, to the eastward of which light northerly winds prevailed with showers of snow, while to the westward moderate easterly breezes were reported drawing to S.E. in the south of Ireland, with cloudy weather. In the north of Scotland light to fresh westerly winds were blowing, which rose to a velocity of 44 miles at Sandwick for a short time. The cold was very severe generally. As the day advanced the barometer fell rapidly on our south-western coasts, *very* unsteadily at Falmouth, accompanied by a rise of the thermometer, and the wind veered more southwards, and rose to a gale in the night. Squalls of snow occurred in many places, the fall in Caithness being large.

Dec. 24. The distribution of pressure over and in the neighbourhood of this country is shown in Fig. 60, Plate LXXII., and the gales reported as then blowing by the arrows drawn. In Norway the barometer had again fallen. A slight anticyclone lay over the south-east of England, while over St. George's Channel gradients for southerly winds had become steep. The cold was very intense in the east of England, while elsewhere the weather became rather warmer. Heavy squalls of snow continued on many parts of the western and northern coasts, but in most other places the weather was fine and the sky comparatively free from cloud. The southerly and south-easterly gale was very severe in the south of Ireland and St. George's Channel, attaining a velocity of 60 miles at Valencia at 2 a.m., and 48 at Falmouth at 6 p.m., but it subsided towards evening without becoming at all general. At Armagh, Glasgow, Stonyhurst, and Kew the weather was nearly absolutely calm.

Dec. 25. A slight fall of the barometer at our south-eastern stations, and apparently a rapid fall in France, accompanied by a rather brisk rise on our western and north-western coasts, had materially altered the relative distribution of pressure, which was now highest over the Irish Sea, North Channel, and west of Scotland, the lowest readings being in France. Gradients were slight in the United Kingdom. In Norway the wind was north-easterly and easterly, while in the north-east of our islands it was light from N. A moderate north-east breeze was reported from our western coasts (which however increased to 46 miles an hour at night), and a light north-east breeze in the English Channel. Temperature again fell in Norway and the south of these islands, the south-east of England being the region of greatest cold. At 8 a.m. the thermometer at Yarmouth stood 18° below freezing point. At Kew the thermogram became indistinct early in the morning, but at 8 a.m., when the trace became legible, the reading was 15°, or 17° below freezing point; but independent records show that it had fallen much below this. At Glasgow and Armagh the thermometer also fell very low early in the morning, and it is remarkable how low it remained all day at the latter station, the minimum recorded being 17° at 8 a.m., while it was 18° at 4 p.m. After this the weather became warmer at all but the south-western observatories, but in the north the change was only temporary. Some more snow fell in the north, but elsewhere the weather was generally fine.

Dec. 26. The rise of the barometer in the north had continued and extended to our southern coasts. Temperature had risen a little in England, but was falling again in Scotland and Norway. Snow continued on the east coast, heavily at Scarborough, and lightning had been seen on the previous night at Shields. In most parts, however, the weather was finer than it had been of late. As the day wore on the wind fell lighter, except in the south-east of England, it having freshened at Yarmouth to N.E. 40 miles by 4 p.m.

Dec. 27. An anticyclone had formed over Scotland and the north-western parts of the North Sea, where temperature fell very low. At Glasgow the reading of the thermometer was rather below 8° at 9 a.m., and down to nearly 13° at Aberdeen two hours earlier. The weather was still cold in other parts of the kingdom also, the snow lying on the ground at Stonyhurst from the 21st to the 30th continuously, and continued so till the end of the month, but from this day the worst of the frost was gone.

Until the end of the 30th the changes in pressure were slight. Moderate to fresh north-easterly and easterly breezes prevailed in this country, reaching a velocity of 40 miles at Yarmouth on the mornings of the 27th and 28th, and 37 miles (from N. by E.) at Holyhead on the 30th, but in Ireland and Scotland the wind was more variable and from the northward. In Scotland temperature rose fast on the evening of the 27th and remained near 32°, but in Ireland the weather became colder. The greatest cold *reported* was, however, on the eastern shores of the North Sea and the south of England. Over France we know that the weather was extremely severe, but the authentic records for the period have not come to hand.

Dec 31. Barometric pressure gave way suddenly in the N. and N.W. accompanied by fresh S. and S.W. winds and increased temperature. In England, where the wind was yet easterly, temperature again fell, and at Stonyhurst the thermometer registered 13°·8 at 10 a.m. In the south of Norway, too, the weather was very cold. The year closed with the barometer still falling in Scotland and Ireland, and rain had set in at Valencia, where the wind was rising to a slight gale.

REMARKS.

Wind.—The following Table gives the number of hours during which the wind blew with a velocity of 30 miles or more an hour, irrespective of its direction, during each month, and the entire quarter.

Observatory.	Oct.	Nov.	Dec.	Total.	Observatory.	Oct.	Nov.	Dec.	Total.
Valencia - -	200	86	138	424	Holyhead - -	279	153	162	594
Armagh - -	12	0	9	21	Stonyhurst -	33	0	8	41
Glasgow - -	38	0	31	69	Alnwick Castle -	48	4	64	116
Aberdeen - -	77	10	74	161	Kew - - -	22	12	8	42
Sandwick - -	86	110	143	339	Yarmouth - -	30	18	123	171
Falmouth - -	198	91	158	447					

As usual Holyhead shows the greatest amount of strong wind, Falmouth and Valencia coming second and third. In December Yarmouth and Alnwick Castle show the effect of the easterly and northerly gales which were experienced, but the more inland observatories are still lowest in the list. November was a rather quiet month.

Taking the results for the whole year, given in the following table, we find Holyhead with by far the largest number; then come Valencia, Sandwick, and Falmouth, and after another considerable step Yarmouth is the next in the scale of number:

Valencia - - - -	1,298	Holyhead - - - -	1,864
Armagh - - - -	112	Stonyhurst - - -	137
Glasgow - - - -	269	*Alnwick Castle - - -	370
Aberdeen - - - -	416	Kew - - - -	128
Sandwick - - - -	1,165	Yarmouth - - -	607
Falmouth - - - -	1,037		

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* For nine months only.

At all the observatories, except Aberdeen, the number of hours of strong wind is lower than the corresponding values for 1869, though the proportion of the deficiency to the whole number is irregular.

Pressure:—

October.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	Inches.	Inches.	Inches.	D. H.	Inches.	D. H.	Inches.
Valencia - -	29·709	− ·211	30·441	1st, noon.	28·819	12th, 7 a.m.	1·622
Armagh - -	29·638	− ·172	30·582	1st, 11 a.m.	28·445	12th, 5 p.m.	2·137
Glasgow - -	29·605	− ·175	30·606	1st, 9 a.m.	28·372	23rd, 11 p.m.	2·237
Aberdeen - -	29·605	− ·180	30·620	1st, 10 a.m. & noon.	28·448	23rd, 10 p.m.	2·172
Falmouth - -	29·809	− ·104	30·500	4th, 10 a.m.	29·050	23rd, 6 a.m.	1·450
Stonyhurst - -	29·661	− ·155	30·639	1st, 9 a.m.	28·572	24th, 3 a.m.	2·067
Kew - - -	29·761	− ·134	30·583	1st, 8 a.m.	28·889	24th, 6 a.m.	1·694

Readings were everywhere considerably below the average, chiefly in Ireland and Scotland. Both the highest and lowest pressures were registered at the northern observatories, where the range was very great. It will be observed that the greatest depression in Ireland occurred on the 12th of the month, while in Great Britain the lowest reading at all the observatories took place during the disturbed weather of the 23rd and 24th.

November.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	Inches.	Inches.	Inches.	D. H.	Inches.	D. H.	Inches.
Valencia - -	29·770	− ·275	30·544	3rd, 10 p.m.	28·826	23rd, 10 p.m.	1·718
Armagh - -	29·778	− ·104	30·597	3rd, midngt.	28·848	23rd, 1 a.m.	1·749
Glasgow - -	29·745	− ·124	30·619	30th, midngt.	28·931	23rd, 4 a.m.	1·688
Aberdeen - -	29·707	− ·164	30·630	30th, 10–11 p.m.	28·914	25th, 5 a.m.	1·716
Falmouth - -	29·830	− ·164	30·535	2nd, 11 a.m.	29·111	24th, 8 p.m.	1·424
Stonyhurst -	29·772	− ·113	30·612	30th, midngt.	28·919	23rd, 5 a.m.	1·693
Kew - - -	29·828	− ·139	30·562	2nd, 10 a.m.	29·101	22nd, 1 p.m.	1·461

Pressure was again below the average at all stations, but the large variation at Valencia seems owing rather to a defect in the average used than to any great local deficit. The maximum pressures were observed at the beginning of the month in the west and south, and at the end of the month in the north, while the minimum occurred everywhere between the 22nd and 25th. The range was greatest in Ireland and Scotland.

December.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	Inches.	Inches.	Inches.	D. H.	Inches.	D. H.	Inches.
Valencia - -	29·895	+ ·081	30·510	3rd, 10 a.m.	28·564	14th, 6 a.m.	1·946
Armagh - -	29·953	+ ·069	30·649	2nd, 11 a.m.	28·678	14th, noon.	1·971
Glasgow - -	29·937	+ ·121	30·687	1st, 9 p.m.	28·732	14th, 5 p.m.	1·955
Aberdeen - -	29·923	+ ·095	30·694	1st. 7 p.m.	28·725	14th, 9 p.m.	1·969
Falmouth - -	29·916	− ·048	30·678	2nd, 11 a.m.	28·940	14th, 7 a.m.	1·738
Stonyhurst -	29·937	+ ·075	30·704	1st, 8 p.m.	28·830	14th, 1 p.m.	1·874
Kew - - -	29·926	− ·106	30·667	2nd, 10 a.m.	29·121	14th, noon.	1·546

Pressure was above the average at the western and northern observatories, especially at Glasgow, but still below the normal level in the south, especially at Kew. The maximum reading occurred at all stations within the first three days of the month, the highest of all being at Stonyhurst, and the minimum was recorded everywhere on the 14th. The range was very large in Ireland and Scotland.

The following short table gives the maximum and minimum pressures recorded in the whole year at each observatory, together with the dates on which they occurred, and the range of pressure experienced.

Observatory.	Maximum.	Date.	Minimum.	Date.	Range.
	Inches.		Inches.		Inches.
Valencia - -	30·598	June 6th, 10 a.m.	28·541	Jan. 8th, 1 a.m.	2·057
Armagh - -	30·649	Dec. 2nd, 11 a.m.	28·445	Oct. 12th, 5 p.m.	2·204
Glasgow - -	*30.691	Jan. 19th, 9 p.m.	28·372	Oct. 23rd, 11 p.m.	2·319
Aberdeen - -	30·731	Jan. 19th, 11 a.m.	28·448	Oct. 23rd, 10 p.m.	2·283
Falmouth - -	30·585	Jan. 18th, 11 a.m.	28·940	Dec. 14th, 7 a.m.	1·645
Stonyhurst - -	30·704	Dec. 1st, 8 p.m.	28·572	Oct. 24th, 3 a.m.	2.132
Kew - - -	†30·667	Dec. 2nd, 10 a.m.	28·889	Oct. 24th, 6 a.m.	1·778

* This value differs by only a few thousandths from that observed in December.
† This value differs by only a few thousandths from the maximum for January.

Thus it appears that the maximum reading occurred at Glasgow, Aberdeen, and Falmouth in January, at which time too the reading at Kew was *very* nearly the same as that recorded as the maximum for the year. At Kew, Stonyhurst, and Armagh, however, the highest readings were registered early in December; while Valencia alone had its maximum in June. With the minimum readings, too, Valencia is alone in January, Falmouth alone in December, all the other observatories having had theirs in October; but even then Armagh differs in the *day* from the rest.

Temperature:—

October.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	°	°	°	D. H.	°	D. H.	°
Valencia - -	53·6	+1·7	68·3	3rd, 4 p.m.	39·0	10th, 3 a.m.	29·3
Armagh - -	47·8	−1·4	64·2	2nd, 1 p.m.	34·0	10th, 6 a.m.	30·2
Glasgow - -	46·6	−0·9	61·6	1st, 2 p.m.	33·7	15th, 3 a.m.	27·9
Aberdeen - -	47·1	+0·8	58·1	1st, 2 p.m.	34·5	15th, 7 a.m.	23·6
Falmouth - -	53·8	—	63·9	8th, 11 a.m.	42·5	10th, 6 a.m.	21·4
Stonyhurst - -	47·8	−0·4	63·8	4th, 2 p.m.	31·2	15th, 6 a.m.	32·6
Kew - - -	50·4	+0·8	67·3	2nd, 1 p.m.	32·6	15th, 6 a.m.	34·7

Taking the British Islands as a whole, the temperature in October was not very far from the average for the month. The highest readings were recorded in the early part of the month, while the lowest were near the middle, the range being greatest at the inland observatories.

November.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	°	°	°	D. H.	°	D. H.	°
Valencia - -	46·5	−0·3	56·5	4th, 1 p.m.	33·8	18th, 8 a.m.	22·7
Armagh - -	41·1	−1·3	52·6	1st, 1 p.m.	29·5	9th, 6 a.m.	23·1
Glasgow - -	39·3	−1·0	51·9	3rd, 2 p.m.	24·9	9th, 1 a.m.	27·0
Aberdeen - -	39·8	−0·1	51·9	3rd, 2 p.m.	29·2	23rd, 7 a.m.	22·7
Falmouth - -	46·4	—	55·7	24th, 11 a.m.	34·3	10th, 3 p.m.	21·4
Stonyhurst - -	39·8	−1·3	52·8	1st, 2 p.m. 24th, 8 p.m.	27·1	9th, 5 a.m.	25·7
Kew - - -	41·3	−1·1	55·4	24th, 11 a.m.	25·6	19th, 1 a.m.	29·8

The month of November was everywhere cold for the time of year. At the Irish and Scotch observatories the maximum temperature occurred in the first few days, but in England it was warmest on the 24th; while the greatest cold occurred in the west of Great Britain and north of Ireland on the 9th or 10th; but elsewhere on different dates later in the month.

December.

Observatory.	Mean.	Difference from Average.	Maximum.	Day and Hour.	Minimum.	Day and Hour.	Range.
	°	°	°	D. H.	°	D. H.	°
Valencia - -	40·8	−5·5	52·7	14th, 5 a.m.	27·2	30th, 9 a.m.	25·5
Armagh - -	34·7	−6·7	50·9	14th, 1 p.m.	13·3	24th, 1 a.m.	37·6
Glasgow - -	33·7	−6·7	50·5	19th, 1 p.m.	7·9	27th, 9 a.m.	42·6
Aberdeen - -	34·3	−4·2	48·9	18th, 5 p.m.	13·3	27th, 7 a.m.	35·6
Falmouth - -	39·2	—	55·5	14th, 7 a.m.	24·0	28th, 1 a.m.	31·5
Stonyhurst - -	33·4	−6·1	53·7	14th, noon.	13·7	31st, 10 a.m.	40·0
Kew - - -	34·2	−4·8	56·1	14th, 10 a.m.	13·0*	25th, 8 a.m.	43·1

The temperature in December was very much below the average in all parts of the kingdom, and the range was very large in nearly all places; at Glasgow, Stonyhurst, and Kew it was from 40° to 43°. The weather was warmest in England and Ireland on the 14th, and in Scotland on the 18th and 19th. The cold was most severe at the latter part of the month, the minima occurring at Armagh early on the morning of the 24th, at Kew on the 25th, in Scotland on the 27th, at Falmouth on the 28th, at Valencia on the 30th, and at Stonyhurst on the 31st. Thus there is no regular progressive motion of the region of greatest cold discernible, and the values of the different minima vary as much as 20° from one another, the lowest of all having been recorded at Glasgow. It is nevertheless worth noting that at Armagh, Aberdeen, Stonyhurst, and Kew, the minima are all almost identical in value though they all differ in date.

The following Table has been drawn up to show the highest and lowest temperature recorded at each observatory in the year, together with their dates, and the range, similarly to that for the pressure.

Observatory.	Maximum.	Date.	Minimum.	Date.	Range.
	°		°		°
Valencia - -	79·6	July 24th, 1 p.m.	27·2	Dec. 30th, 9 a.m.	52·4
Armagh - -	79·6	„ 23rd, 2 p.m.	13·3	„ 24th, 1 a.m.	66.3
Glasgow - -	84·5	„ 24th, 4 p.m.	7·9	„ 27th, 9 a.m.	76·6
Aberdeen - -	77·7	June 21st, 5 p.m.	13·3	„ 27th, 7 a.m.	64·4
Falmouth - -	76·3	Aug. 11th, 1 p.m.	24·0	„ 28th, 1 a.m.	52·3
Stonyhurst - -	80.8	July 25th, 3 p.m.	13·7	„ 31st, 10 a.m.	67·1
Kew - - -	85·4	„ 22nd, 3 p.m.	13·0*	„ 25th, 8 a.m.	72·4

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* This is the lowest reading measurable on the curve which became illegible for a few hours, so that the absolute minimum was probably lower than 13°.

Thus we have readings above 80° recorded at Kew, Glasgow, and Stonyhurst, all in the latter part of July. The lowest is at Glasgow (and it will be observed that the lowest temperature at all the observatories occurred in December); while the greatest ranges are found at Glasgow and Kew. This very great range at Glasgow is very remarkable, as it is not entirely owing to the exceptionally low reading on the 27th of December, the maximum temperature in July also having been exceptional for the locality. The range at all the northern observatories and Kew was considerably in excess of that for 1869.

The next Table gives, as usual, the variation of the five day means of temperature at Kew from the averages of 43 years' observations at Greenwich.

Date.	Variation.	Date.	Variation.	Date.	Variation.
Sept. 28–Oct. 2	°0·0	Oct. 28–Nov. 1	− °0·1	Nov. 27–Dec. 1	− °1·2
Oct. 3–7 -	− 1·9	Nov. 2–6 -	− 3·4	Dec. 2–6 -	− 2·7
„ 8–12 -	− 5·9	„ 7–11 -	− 9·1	„ 7–11 -	− 6·5
„ 13–17 -	− 3·0	„ 12–16 -	− 7·0	„ 12–16 -	− 1·8
„ 18–22 -	− 0·1	„ 17–21 -	− 2·9	„ 17–21 -	− 1·0
„ 23–27 -	− 0·4	„ 22–26 -	+ 2·7	„ 22–27 -	−12·9
				„ 27–31 -	−10·1

Note.—In the Tables showing the monthly values the comparison has been made with averages, also given by Dove, but from a different station; hence the want of agreement in the results.

With the exception of the periods from September 28th to October 2nd, and from November 22nd to 26th, the temperature has been low for the whole quarter. In fact this was true from the 19th August to the end of the year. For the last 10 days in December the deficit was very large, and also in the middle of November.

APPENDIX.

APPENDIX I.

TABLE I.—MEAN MONTHLY RESULTS from the continuous RECORDS at the SEVEN BRITISH OBSERVATORIES, for the Year 1870.

VALENCIA.

MONTHS.	THERMOMETER.					BAROMETER.					PRESSURE.	
	Means.	Extremes.				Means.	Extremes.				Vap.	Dry Air.
		Maximum.		Minimum.			Maximum.		Minimum.			
		Day.	Ther.	Day.	Ther.		Day.	Bar.	Day.	Bar.		
	°	D. H.	°	D. H.	°	In.	D. H.	In.	D. H.	In.	In.	In.
January -	44·3	16 0	53·2	21 11	31·3	29·852	22 23	30·543	7 13	**28·516**	·229	29·623
February -	41·7	5 19	52·3	13 10	30·3	29·737	11 20	30·482	27 8	28·726	·207	29·530
March -	45·6	18 2	57·6	{ 22 16 4 17 }	34·4	30·078	6 11	30·472	15 11	29·301	·250	29·828
April -	49·7	17 4	61·5	14 18	37·8	30·112	15 12	30·499	8 14	29·063	·281	29·831
May -	52·4	25 3	65·6	1 18	40·7	29·951	{ 24 11 & 21 }	30·453	11 17	28·743	·321	29·630
June -	57·7	7 1	73·5	16 13	49·0	30·179	5 22	**30·573**	1 0	29·852	·395	29·784
July -	60·9	24 1	**79·6**	1 17	51·2	29·997	19 10	30·329	11 22	29·689	·465	29·532
August -	61·6	13 1	77·6	30 15	46·2	30·016	30 10	30·373	4 16	29·520	·420	29·596
September	58·6	22 2	71·0	10 15	45·2	29·989	16 10	30·465	8 12	29·114	·400	29·589
October -	53·6	3 4	68·3	9 15	39·0	29·684	1 0	30·416	11 19	28·795	·335	29·349
November	46·5	4 1	56·5	17 20	33·8	29·745	3 10	30·518	23 10	28·802	·257	29·488
December	40·8	13 17	52·7	29 21	**27·2**	29·869	2 22	30·483	13 18	28·540	·199	29·670

ARMAGH.

MONTHS.	THERMOMETER.					BAROMETER.					PRESSURE.	
	Means.	Extremes.				Means.	Extremes.				Vap.	Dry Air.
		Maximum.		Minimum.			Maximum.		Minimum.			
		Day.	Ther.	Day.	Ther.		Day.	Bar.	Day.	Bar.		
	°	D. H.	°	D. H.	°	In.	D. H.	In.	D. H.	In.	In.	In.
January -	39·0	16 3	51·1	24 15	23·7	29·651	19 9	30·397	7 17	28·278	·213	29·438
February -	38·3	6 4	50·9	12 20	26·5	29·590	12 0	30·380	28 15	28·667	·193	29·397
March -	42·0	19 2	58·6	12 18	25·2	29·888	5 23	30·361	15 16	29·017	·216	29·672
April -	48·1	17 3	64·6	17 16	34·8	29·861	15 22	30·305	8 18	29·089	·257	29·604
May -	51·8	21 4	71·3	1 17	37·0	29·735	24 21	30·295	12 1	28·557	·296	29·439
June -	57·6	6 2	73·6	11 17	44·6	29·908	5 19	30·409	10 5	29·429	·369	29·539
July -	60·5	23 2	**79·6**	26 17	45·0	29·771	27 21	30·107	3 16	29·419	·419	29·352
August -	58·8	10 4	78·0	29 18	42·4	29·806	13 23	30·166	27 14	29·212	·374	29·432
September	55·4	22 2	69·6	30 16	40·7	29·768	30 23	30·351	8 19	28·732	·359	29·409
October -	47·8	2 1	64·2	9 18	34·0	29·416	1 0	30·345	12 5	**28·238**	·287	29·129
November	41·1	1 1	52·6	8 18	29·5	29·548	{ 3 12 30 23 }	30·360	22 13	28·624	·224	29·324
December	34·7	14 1	50·9	23 13	**13·3**	29·717	1 23	**30·411**	14 0	28·459	·175	29·542

The barometrical readings are reduced to 32°, but not to sea level. See headings to Table II.

Table I.—Mean Monthly Results, &c.—*continued.*

GLASGOW.

Months.	Thermometer.					Barometer.					Pressure.	
	Means.	Extremes.				Means.	Extremes.				Vap.	Dry Air.
		Maximum.		Minimum.			Maximum.		Minimum.			
		Day.	Ther.	Day.	Ther.		Day.	Bar.	Day.	Bar.		
	°	D. H.	°	D. H.	°	In.	D. H.	In.	D. H.	In.	In.	In.
January -	36·9	7 2	44·7	26 17	26·0	29·711	19 9	**30.478**	7 22	28·388?	·188	29·523
February -	36·4	28 18	49·0	24 14	16·0	29·644	11 22	30·433	28 17	28·735	·177	29·467
March -	39·7	31 2	55·5	13 19	24·3	29·884	5 20	30·386	1 0	29·084	·189	29·695
April -	46·9	18 3	69·7	2 19	31·4	29·824	16 0	30·286	30 8	29·080	·235	29·589
May -	50·9	27 4	70·9	3 17	32·5	29·732	25 11	30·249	12 5	28·736	·275	29·457
June -	55·5	6 4	76·0	9 14	43·6	29·862	5 18	30·401	10 14	29·330	·337	29·525
July -	59·6	24 4	**84·5**	2 17 28 18	46·7	29·761	27 20	30·128	3 20	29·347	·395	29·366
August -	57·7	10 4	77·6	26 17 28 18	40·9	29·812	13 12 18	30·213	27 16	29·316	·355	29·457
September	53·4	23 2	66·9	14 18	36·3	29·760	30 21	30·399	9 13	28·498	·333	29·427
October -	46·6	1 2	61·6	14 15	33·7	29·404	1 13	30·395	23 11	**28·179**	·257	29·147
November	39·3	3 2	51·9	8 13	24·9	29·539	30 23	30·455	22 16	28·729	·201	29·338
December	33·7	19 1	50·5	26 21	**7·9**	29·727	1 9	30·475	14 5	28·536	·185	29·542

The minimum barometrical reading for January is left doubtful owing to the gas being out for seven hours on the day in question.

ABERDEEN.

Months.	Thermometer.					Barometer.					Pressure.	
	Means.	Extremes.				Means.	Extremes.				Vap.	Dry Air.
		Maximum.		Minimum.			Maximum.		Minimum.			
		Day.	Ther.	Day.	Ther.		Day.	Bar.	Day.	Bar.		
	°	D. H.	°	D. H.	°	In.	D. H.	In.	D. H.	In.	In.	In.
January -	37·1	18 2 4 1	43·7	26 15	24·6	29·750	18 23	**30·630**	8 0	28·492	·185	29·565
February -	35·7	28 23	47·2	23 12	22·9	29·771	12 12	30·605	28 19	28·891	·180	29·591
March	39·1	19 4	55·3	11 17	22·3	29·958	5 11	30·477	1 0	29·101	·195	29·763
April -	46·4	25 3	65·4	3 17	33·7	29·855	3 1	30·363	30 7	29·067	·216	29·639
May -	49·9	18 4	63·1	2 14	35·0	29·813	25 9	30·348	12 7	28·977	·270	29·543
June -	54·8	21 5	**77·7**	9 16	42·1	29·924	4 22	30·523	10 21	29·329	·310	29·614
July -	58·5	23 3	74·0	2 10	47·0	29·846	27 21	30·241	3 22	29·365	·370	29·476
August -	56·1	31 2	67·9	28 14	44·8	29·912	13 10	30·328	27 19	29·511	·340	29·572
September	54·2	29 3	66·9	8 13	38·8	29·843	30 22	30·522	9 12	28·823	·323	29·520
October -	47·1	1 2	58·1	14 19	34·5	29·508	1 0	30·522	23 10	**28·354**	·252	29·256
November	39·8	3 2	51·9	22 19	29·2	29·609	30 23	30·566	24 17	28·819	·215	29·394
December	34·3	18 5	48·9	26 19	**13·3**	29·822	1 7	30·589	14 9	28·631	·172	29·650

The barometrical readings are reduced to 32°, but not to sea level. See headings to Table II.

Table I.—Mean Monthly Results, &c.—*continued.*

FALMOUTH.

Months.	Thermometer.					Barometer.					Pressure.	
	Means.	Extremes.				Means.	Extremes.				Vap.	Dry Air.
		Maximum.		Minimum.			Maximum.		Minimum.			
		Day.	Ther.	Day.	Ther.		Day.	Bar.	Day.	Bar.		
	°	D. H.	°	D. H.	°	In.	D. H.	In.	D. H.	In.	In.	In.
January -	43·4	16 1	54·4	22 21	30·3	29·768	17 23	**30·350**	7 18	28·945	·221	29·547
February -	40·5	26 1	51·1	10 16	25·0	29·580	11 8	30·119	27 13	29·025	·209	29·371
March -	43·2	18 1	56·0	26 18	33·0	29·836	19 22	30·261	2 16	29·013	·219	29·617
April -	48·0	20 5	58·2	4 18	36·5	29·965	15 23	30·320	8 20	29·222	·257	29·708
May -	52·4	19 3	66·2	2 15	38·2	29·859	24 20	30·212	11 3	29·017	·300	29·559
June -	59·3	22 2	74·9	2 16	47·7	29·979	5 21	30·338	16 14	29·670	·362	29·617
July -	62·3	25 2	74·2	1 15	52·7	29·810	19 12 19 20	30·138	24 14	29·492	·437	29·373
August -	61·7	11 1	**76·3**	30 17	48·5	29·809	30 11	30·145	6 15	29·368	·400	29·409
September	58·5	2 1	67·1	10 16	50·0	29·863	16 9	30·299	6 18	29·118	·387	29·476
October -	53·8	7 23	63·9	9 18	42·5	29·582	3 22	30·262	22 18	28·826	·335	29·247
November	46·4	23 23	55·7	10 3	34·3	29·587	1 23	30·298	24 8	28·888	·250	29·337
December	39·2	13 19	55·5	27 13	**24·0**	29·680	1 23	30·336	13 19	**28·717**	·197	29·483

STONYHURST.

Months.	Thermometer.					Barometer.					Pressure.	
	Means.	Extremes.				Means.	Extremes.				Vap.	Dry Air.
		Maximum.		Minimum.			Maximum.		Minimum.			
		Day.	Ther.	Day.	Ther.		Day.	Bar.	Day.	Bar.		
	°	D. H.	°	D. H.	°	In.	D. H.	In.	D. H.	In.	In.	In.
January -	37·5	7 13	48·3?	26 17	22·3	29·539	18 23	30·243	7 21	28·239	·193	29·346
February -	36·7	28 3	51·4	12 12	22·5	29·453	11 23	30·150	27 16	28·823	·178	29·275
March -	39·5	19 1 31 4	52·4	27 18	26·2?	29·713	5 21	30·113	15 20	29·010	·185	29·528
April -	47·4	20 3	71·7	5 17	32·7	29·699	15 22	30·120	30 17	28·964	·237	29·462
May -	51·6	21 4	71·0	3 17	31.3	29·611	25 12	30·062	11 5	28·761	·281	29·330
June -	56·9	7 5	74·6	1 16	45·4	29·715	5 10	30·216	10 11	29·262	·352	29·363
July -	61·2	25 3	**80·8**	12 15	48·1	29·601	19 12	29·911	3 19	29·296	·412	29·189
August -	59·0	2 4 12 3	78·9	30 18	37·8	29·611	12 20	29·974	4 16	29·264	·348	29·263
September	54·4	27 3	67·7	14 17	36·4	29·643	30 21	30·236	9 14	28·732	·333	29·310
October -	47·8	4 2	63·8	14 18	31·2	29·268	1 0	30·229	23 15	**28·189**	·274	28·994
November	39·8	1 2 24 8	52·8	8 17	27·1	29·372	30 23	30·239	22 17	28·531	·207	29·165
December	33·4	14 0	53·7	30 22	**13·7**	29·526	1 8	**30·284**	14 1	28·450	·166	29·360

Two days' omissions in January leave the maximum temperature doubtful.
" " March " minimum " "

Table 1.—Mean Monthly Results, &c.—*continued.*

KEW.

Months.	Thermometer.					Barometer.					Pressure.	
	Means.	Extremes.				Means.	Extremes.				Vap.	Dry Air.
		Maximum.		Minimum.			Maximum.		Minimum.			
		Day.	Ther.	Day.	Ther.		Day.	Bar.	Day.	Bar.		
	°	D. H.	°	D. H.	°	In.	D. H.	In.	D. H.	In.	In.	In.
January -	39·7	7 15	51·6	29 18	24·0?	29·983	17 23	30·623	8 0	29·041	·207	29·776
February -	37·0	28 1	53·2	11 19	21·4	29·841	11 22	30·355	24 3	29·355	·184	29·657
March -	40·2	2 2	59·0	13 18	22·6	30·033	19 13 28 1	30·460	2 17	29·458	·198	29·835
April -	48·7	20 2	75·6	3 17	26·0	30·120	3 20	30·521	9 0	29·449	·224	29·896
May -	53·5	19 3	75·6	3 17	32·4	30·045	25 11	30·432	11 9	29·327	·273	29·772
June -	61·7	19 5	79·6	5 16	44·5	30·097	5 12 19	30·533	10 4	29·694	·358	29·739
July -	65·9	25 2	**85·0**	1 14	46·0	29·957	19 20	30·281	11 15	29·627	·424	29·533
August -	61·1	6 4 18 3	78·3	30 18	42·2	29·954	30 12	30·303	28 0	29·394	·366	29·588
September	55·5	28 2	70·8	14 17	38·4	30·059	15 22	30·518	7 5	29·291	·342	29·717
October -	50·4	2 1	67·3	14 18	32·6	29·723	1 0	30·527	23 18	**28·852**	·296	29·427
November	41·3	23 23	55·4	18 13	25·6	29·789	30 22	30·567	22 1	29·064	·221	29·568
December -	34·2	13 22	56·1	24 20	**13.0**	29·887	1 22	**30·626**	14 0	29·085	·172	29·715

Two days' omissions in January make the minimum temperature doubtful.

TABLE II.—PART 1.

FIVE DAY MEANS of the DRY and WET THERMOMETERS and BAROMETER, from the continuous Records at the Seven BRITISH OBSERVATORIES, January to June 1870.

Five Day Periods.	Thermometer.														Barometer.							Five Day Periods.
	Valencia. 12 ft.		Armagh. 4 ft.		Glasgow. 7 ft.		Aberdeen. 41 ft.		Falmouth. 11 ft.		Stonyhurst. 7 ft.		Kew. 10 ft.		Valencia. 23 ft.	Armagh. 207 ft.	Glasgow. 184 ft.	Aberdeen. 88 ft.	Falmouth. 211 ft.	Stonyhurst. 361 ft.	Kew. 34 ft.	
	Dry.	Wet.	Dry.	Wet.	Dry.	Wet.	Dry.	Wet.	Dry.	Wet.	Dry.	Wet.	Dry.	Wet.								
Jan. 1–5	45·0	43·0	40·0	38·9	40·2	39·1	39·2	38·1	47·5	45·8	42·7	41·4	45·9	44·6	29·448	29·242	29·261	29·349	29·419	29·163	29·674	Jan. 1–5
„ 6–10	45·7	42·9	38·9	37·9	38·3	36·5	38·0	36·3	45·3	42·9	39·3	37·9	42·2	40·2	29·483	29·170	30·222[a]	29·162	29·405	29·003	29·536	„ 6–10
„ 11–15	46·8	44·3	39·5	38·4	36·1	34·7	35·9	34·2	46·5	44·5	39·2	37·8	41·4	39·7	29·708	29·372	29·403	29·386	29·653	29·249	29·769	„ 11–15
„ 16–20	45·4	43·5	41·7	40·2	36·7	35·4	38·2	36·5	42·2	40·1	37·9	36·9	37·8	35·7	30·421	30·272	30·310	30·419	30·232	30·114	30·449	„ 16–20
„ 21–25	37·4	34·5	33·9	33·1	32·6	31·7	35·9	34·4	36·4	32·2	32·5	30·7	34·5	32·3	30·456	30·292	30·289	30·365	30·190	30·084	30·385	„ 21–25
„ 26–30	45·4	42·3	39·6	37·2	36·9	34·4	34·8	32·5	42·4	39·1	32·6	30·6	30·8[b]	—[c]	29·656	29·628	29·752	29·868	29·744	29·660	30·111	„ 26–30
Feb. 31–4	45·4	43·0	42·2	40·6	42·7	40·7	41·1	40·0	45·9	44·4	42·7	41·3	43·8	42·5	29·408	29·242	29·323	29·466	29·414	29·239	29·755	Feb. 31–4
„ 5–9	43·7	41·4	39·2	37·7	37·7	35·6	37·6	36·2	43·7	41·8	36·9	35·1	38·4	37·3	29·464	29·410	29·571	29·789	29·412	29·379	29·776	„ 5–9
„ 10–14	34·6	31·0	31·4	29·6	32·5	30·7	33·0	30·9	30·2	29·1[d]?	28·6	26·6	27·4	26·0	30·273	30·230	30·318	30·475	29·906	29·994	30·196	„ 10–14
„ 15–19	38·5	35·0	36·6	34·7	36·5	34·1	37·6	35·8	35·9	33·1	36·2	33·9	33·2	30·9	30·139	30·006	30·022	30·099	29·852	29·752	30·048	„ 15–19
„ 20–24	44·6	41·8	38·9	37·2	33·0	30·8	30·4	28·9	42·1	39·5	35·0	32·9	36·3	33·8	29·804	29·461	29·386	29·422	29·589	29·230	29·672	„ 20–24
Mar. 25–1	44·4	42·2	40·8	39·3	38·1	36·5	36·7	35·0	47·5	45·9	42·4	40·0	46·9	44·7	29·244	29·074	29·112	29·222	29·252	29·012[e]	29·558	Mar. 25–1
„ 2–6	40·5	37·3	36·9	34·5	36·3	33·6	38·2	35·1	42·6	40·2	37·6	34·7	40·8	38·7	30·000	29·970	30·045	30·176	29·673	29·836	29·945	„ 2–6
„ 7–11	44·6	41·5	40·6	38·3	39·8	36·2	39·5	37·1	42·9	39·7	40·7	37·2	41·0	38·0	30·251	30·018	29·948	29·966	29·937	29·715	30·035	„ 7–11
„ 12–16	46·5	44·5	41·6	39·7	38·0	35·8	36·3	35·0	44·5	42·1	38·4	36·0	39·5	—[f]	29·688	29·462	29·470	29·559	29·638	29·345	29·822	„ 12–16
„ 17–21	50·3	48·6	48·8	46·6	45·1	43·3	43·7	41·5	47·0	44·8	45·4	44·0	44·6	42·2	30·276	30·013	29·965	30·015	29·829	29·819	30·215	„ 17–21
„ 22–26	43·0	40·6	36·2	34·2	34·6	31·7	34·7	32·7	40·1	36·8	34·6	31·4	36·0	32·6	30·049	29·869	29·875	29·954	29·810	29·620	29·933	„ 22–26
„ 27–31	49·1	47·2	47·7	45·8	43·9	41·6	41·9	40·0	40·8	37·7	39·7	36·9	37·0	34·2	30·329	30·114	30·130	30·212	29·986	29·968	30·330	„ 27–31
Apr. 1–5	48·6	45·5	47·2	43·4	43·6	40·2	44·7	40·7	44·0	40·9	45·1	40·6	40·1	36·5	30·280	30·093	30·094	30·156	30·094	29·936	30·327	Apr. 1–5
„ 6–10	48·0	44·9	44·7	42·3	43·5	40·3	44·1	40·1	47·3	43·9	44·9	41·8	47·1	42·7	29·764	29·494	29·464	29·513	29·643	29·346	29·776	„ 6–10
„ 11–15	49·9	48·5	49·9	46·9	48·2	44·8	49·1	43·7	48·9	46·4	47·1	44·8	50·3	45·5	30·227	29·994	29·943	29·964	30·112	29·829	30·247	„ 11–15
„ 16–20	52·3	49·2	51·5	47·1	52·1	47·0	46·0	43·5	49·0	46·6	54·0	47·9	54·5	48·6	29·953	29·851	29·921	30·019[g]	29·900	29·774	30·162	„ 16–20
„ 21–25	50·7	48·0	49·7	46·8	48·7	45·8	51·7	45·7	50·6	46·9	49·3	46·1	53·8	47·4	30·260	29·927	29·848	29·842	30·173	29·822	30·290	„ 21–25
„ 26–30	48·7	46·0	45·6	43·0	45·2	40·7	43·0	39·5	48·0	44·3	44·0	40·4	46·2	42·0	30·191	29·805	29·672	29·666	29·868	29·509	29·918	„ 26–30
May 1–5	48·4	45·2	45·6	41·9	45·5	39·8	43·5	40·1	46·9	42·6	44·2	40·1	44·9	40·4	30·245	29·971	29·899	29·930	29·942	29·680	30·041	May 1–5
„ 6–10	51·6	49·3	49·6	46·3	51·1	46·3	48·1	44·5	49·6	46·2	50·0	45·7	46·9	43·2	30·011	29·900	29·921	30·051	29·897	29·745	30·128	„ 6–10
„ 11–15	50·4	47·8	49·6	46·8	49·3	46·2	50·1	46·4	52·5	49·9	50·5	56·9	54·0	50·2	29·389	29·131	29·183	29·301	29·463	29·143	29·702	„ 11–15
„ 16–20	54·1	52·6	55·2	52·3	52·2	49·7	53·8	49·5	54·6	51·5	55·1	51·5	58·9	52·5	29·951	29·710	29·703	29·735	29·983	29·664	30·158	„ 16–20
„ 21–25	54·0	51·4	54·1	50·6	51·4	48·2	52·5	47·9	54·4	50·6	53·5	49·8	58·0	51·2	30·288	30·042	29·984	30·021	30·072	29·854	30·226	„ 21–25
„ 26–30	55·6	52·2	57·1	53·0	55·7	51·9	51·2	48·9	55·9	52·2	56·5	52·0	57·7	52·0	29·854	29·711	29·792	29·937	29·832	29·649	30·068	„ 26–30
June 31–4	57·0	55·1	56·9	54·2	55·2	52·2	52·1	49·3	57·3	53·5	54·4	51·4	59·5	54·7	30·055	29·836	29·813	29·915	29·938	29·678	30·068	June 31–4
„ 5–9	60·5	57·8	59·7	55·7	58·7	54·1	53·5	50·3	60·0	54·1	59·5	53·4	58·7	51·8[h]	30·334	30·092	30·040	30·108	30·051	29·858	30·190	„ 5–9
„ 10–14	56·9	54·6	56·1	53·2	53·8	50·7	53·8	49·6	58·4	54·5	54·9	51·9	61·7	55·1	30·020	29·719	29·686	29·741	29·920	29·592	30·032	„ 10–14
„ 15–19	57·4	55·1	58·4	55·1	55·8	52·5	57·7	53·0	59·4	56·6	59·1	56·1	65·3	59·3	30·011	29·764	29·755	29·815	29·904	29·630	30·051	„ 15–19
„ 20–24	57·7	54·4	58·1	53·7	55·4	51·2	58·1	51·7	61·4	55·8	58·3	53·9	65·3	57·4	30·324	30·028	29·961	29·983	30·052	29·808	30·156	„ 20–24
„ 25–29	56·4	53·3	55·6	52·2	54·5	50·7	53·9	49·3	58·3	53·1	54·7	51·5	59·4	53·2	30·243	29·921	29·821	29·879	29·954	29·653	30·032	„ 25–29

[a] Mean of 4 days, the gas was out on the 7th, probable mean of 5 days 29·120.

[b] Mean of 3 days by thermograph, 2 days supplied from maximum and minimum at Kew.

[c] Two days deficient, probable mean of 5 days 29°·7.

[d] The tabulations from the 10th to the 14th are marked doubtful, and the curve has not been reproduced in the plates.

[e] Mean of 4 days, probable mean of 5 days 29·040.

[f] Two days deficient owing to frost, probable mean of 5 days 36°·4.

[g] Mean of 4 days, probable mean of 5 days 30·050.

[h] Mean of 3 days, gas failed on 5th and 6th, probable mean of 5 days 50°·9.

TABLE II.—Part 2.

FIVE DAY MEANS of the DRY and WET THERMOMETERS and BAROMETER, from the continuous Records at the Seven BRITISH OBSERVATORIES, July to December 1870.

Five Day Periods.	Thermometer.														Barometer.							Five Day Periods.
	Valencia. 12 ft.		Armagh. 4 ft.		Glasgow. 7 ft.		Aberdeen. 41 ft.		Falmouth. 11 ft.		Stonyhurst. 7 ft.		Kew. 10 ft.		Valencia. 23 ft.	Armagh. 207 ft.	Glasgow. 184 ft.	Aberdeen. 88 ft.	Falmouth. 211 ft.	Stonyhurst. 361 ft.	Kew. 34 ft.	
	Dry.	Wet.	Dry.	Wet.	Dry.	Wet.	Dry.	Wet.	Dry.	Wet.	Dry.	Wet.	Dry.	Wet.								
June 30–4	57·4	54·9	56·3	53·3	55·3	51·6	54·5	49·5	59·0	55·0	55·1	52·4	59·6	54·2	30·010	29·721	29·647	29·702	29·866	29·520	29·949	June 30–4
July 5–9	59·1	57·2	59·7	57·0	58·2	55·2	59·2	54·0	61·4	58·4	61·3	57·3	66·9	60·3	29·913	29·690	29·672	29·732	29·785	29·547	29·937	July 5–9
,, 10–14	59·3	57·0	59·8	56·0	58·3	55·2	57·8	55·0	61·3	57·2	58·8	55·2	65·2	59·3	29·835	29·608	29·590	29·670	29·682	29·457	29·822	,, 10–14
,, 15–19	59·7	58·0	59·8	57·4	58·7	55·6	59·4	55·8	61·7	58·8	60·9	57·4	66·9	59·5	30·065	29·798	29·780	29·845	29·911	29·649	30·042	,, 15–19
,, 20–24	65·8	62·4	65·9	61·8	65·1	60·6	62·5	58·0	65·3	60·8	66·5	60·8	70·9	61·7	30·037	29·852	29·864	29·946	29·856	29·719	30·066	,, 20–24
,, 25–29	62·4	57·9	59·5	54·9	60·6	55·5	57·2	53·1	63·1	58·0	61·6	56·3	64·3	59·1	30·185	29·991	29·995	30·126	29·863	29·744	30·010	,, 25–29
,, 30–3	62·0	58·9	63·9	60·4	60·6	57·7	57·4	55·9	64·8	61·7	65·5	61·4	65·6	62·6	29·853	29·677	29·737	29·876	29·627	29·503	29·809	,, 30–3
Aug. 4–8	61·0	58·3	62·0	58·5	62·8	58·7	59·8	59·0	63·7	60·1	63·4	58·5	65·1	60·1	29·745	29·604	29·673	29·825	29·616	29·478	29·841	Aug. 4–8
,, 9–13	64·4	60·6	64·3	58·7	62·5	57·3	58·5	54·4	65·4	59·8	64·2	56·9	65·4	58·5	30·236	30·068	30·099	30·215	30·005	29·876	30·160	,, 9–13
,, 14–18	62·9	57·7	58·7	53·4	58·2	53·4	56·2	52·3	62·0	56·9	58·8	53·5	61·4	55·3	30·075	29·945	29·933	30·029	29·821	29·706	30·000	,, 14–18
,, 19–23	61·4	57·3	55·2	51·1	54·2	50·1	54·0	49·8	59·2	53·7	54·6	50·1	56·9	51·3	30·091	29·840	29·782	29·852	29·874	29·602	29·972	,, 19–23
,, 24–28	60·5	55·9	54·6	51·1	52·5	48·2	52·7	48·5	59·8	55·0	53·9	49·8	58·3	51·8	29·974	29·670	29·631	29·715	29·736	29·417	29·789	,, 24–28
,, 29–2	57·5	53·4	54·5	51·3	54·1	50·9	54·4	49·9	57·9	53·3	54·3	50·5	57·2	52·2	29·870	29·617	29·564	29·611	29·740	29·455	29·892	,, 29–2
Sept. 3–7	56·6	52·9	53·6	50·6	53·5	50·5	54·8	50·5	58·0	54·3	54·7	51·0	57·5	54·4	29·498	29·253	29·219	29·287	29·443	29·148	29·631	Sept. 3–7
,, 8–12	56·4	52·9	53·8	50·7	51·4	48·1	51·0	46·9	57·3	53·4	52·5	48·9	56·2	52·0	29·830	29·464	29·398	29·484	29·728	29·339	29·849	,, 8–12
,, 13–17	60·2	58·2	54·5	52·8	52·2	49·2	52·9	49·3	58·9	56·6	53·2	50·5	54·0	50·6	30·229	30·004	29·972	30·044	30·068	29·833	30·239	,, 13–17
,, 18–22	61·6	57·8	58·6	55·2	54·7	52·3	55·6	52·3	59·0	56·3	56·4	53·7	54·0	51·5	30·171	30·038	30·073	30·152	30·051	29·934	30·305	,, 18–22
,, 23–27	59·1	57·1	57·7	55·2	55·3	52·2	55·5	52·8	58·5	55·2	54·8	50·8	53·4	50·1	30·198	30·045	30·095	30·208	30·032	29·923	30·257	,, 23–27
,, 28–2	57·9	54·7	53·1	51·1	50·7	48·9	53·8	51·7	58·4	55·4	53·7	50·9	55·2	51·7	30·352	30·237	30·286	30·397	30·168	30·119	30·436	,, 28–2
Oct. 3–7	59·0	55·4	50·5	49·0	47·8	45·9	49·1	45·8	57·9	55·9	49·2	46·6	53·1	50·8	29·954	29·872	29·951	30·087	29·855	29·731	30·098	Oct. 3–7
,, 8–12	51·6[a]	—[b]	45·3	43·5	43·9	40·5	44·6	41·5	53·5	50·0	44·7	42·2	48·6	45·3	29·377	29·147	29·190	29·312	29·264	28·951	29·396	,, 8–12
,, 13–17	52·7	49·7	47·9	46·0	46·4	44·2	45·9	43·0	53·3	50·5	46·5	44·4	48·9	46·4	29·621	29·348	29·312	29·400	29·548	29·224	29·703	,, 13–17
,, 18–22	52·7	49·7	49·5	47·8	48·5	46·0	49·7	47·4	52·6	49·7	49·2	47·0	51·4	49·1	29·501	29·138	29·127	29·193[c]	29·470	29·060	29·597	,, 18–22
,, 23–27	50·5	46·5	44·9	42·9	46·1	43·8	46·0	43·1	50·1	46·9	46·9	44·5	47·9	45·0	29·485	29·027	28·908	28·946	29·344	28·858	30·388	,, 23–27
,, 28–1	52·7	50·6	46·4	44·8	45·0	42·7	44·4	41·9	52·5	50·3	46·5	44·4	48·5	46·1	30·049	29·782	29·725	29·772	29·909	29·595	30·000	,, 28–1
Nov. 2–6	50·5	48·6	45·9	44·0	44·6	42·5	45·2	42·7	48·5	45·2	42·8	41·4	41·9	40·3	30·397	30·202	30·165	30·221	30·188	29·997	30·374	Nov. 2–6
,, 7–11	44·4	41·3	36·9	35·4	34·2	31·8	36·4	35·0	43·6	40·8	35·3	32·8	38·3	36·7	29·923	29·711	29·671	29·698	29·595	29·417	29·733	,, 7–11
,, 12–16	43·4	40·6	37·2	36·1	37·9	35·8	37·8	36·5	42·2	39·9	36·1	34·7	37·2	35·8	29·447	29·102	29·012	29·038	29·189	28·842	29·294	,, 12–16
,, 17–21	43·9	41·6	39·3	38·3	39·8	38·0	40·5	39·2	44·7	42·4	39·2	37·7	39·7	38·4	29·301	29·057	29·051	29·149	29·211	28·945	29·440	,, 17–21
,, 22–26	45·7	43·9	41·0	39·7	39·5	38·3	38·9	37·7	50·5	48·6	43·7	42·4	48·6	46·7	29·278	29·105	29·132	29·221	29·263	29·008	29·521	,, 22–26
,, 27–1	49·3	46·9	45·4	42·7	38·9	36·7	38·6	37·3	47·0	44·2	40·7	38·5	40·6	38·3	30·127	30·142	30·244	30·373	30·077	30·050	30·396	,, 27–1
Dec. 2–6	43·4	40·2	39·3	37·8	38·9	37·0	39·4	38·1	39·6	37·0	38·9	36·7	34·7	33·0	30·360	30·154	30·121	30·184	30·031	29·852	30·165	Dec. 2–6
,, 7–11	39·2	36·5	35·2	33·9	34·8	33·2	35·6	33·6	38·0	35·4	33·8	32·3	33·6	32·6	29·695	29·581	29·663	29·822	29·523	29·405	30·753	,, 7–11
,, 12–16	44·7	42·7	36·9	36·2	37·5	35·9	38·6	36·8	49·2	48·0	38·3	36·4	45·7	44·8	29·352	29·200	29·176	29·254	29·262	29·064	30·522	,, 12–16
,, 17–21	44·8	42·8	40·2	38·8	38·3	36·7	34·9	34·2	43·8	41·9	38·1	36·7	39·7	37·6	29·936	29·647	29·606	29·719	29·740	29·452	30·856	,, 17–21
,, 22–26	35·9	33·2	24·6	24·0	22·8	22·5	27·0	26·0	32·0	30·0	24·2	22·9	24·4	23·4	29·748	29·706	29·725	29·778	29·589	29·510	30·841	,, 22–26
,, 27–31	35·9	33·6	30·7	29·0	29·3	—[d]	30·2	28·8	31·9	30·6	26·9	25·8	26·6	25·3	30·017	29·882	29·922	30·028	29·818	29·728	30·046	,, 27–31

[a] Curve indistinct on 9th and 10th.

[b] Two days deficient, probable mean of 5 days 48·6.

[c] Mean of 3 days, probable mean of 5 days 29·250.

[d] Two days deficient owing to frost, probable mean for 5 days 28·5.

APPENDIX II.

MEAN BAROMETRICAL PRESSURE at TELEGRAPHIC REPORTING STATIONS on the Coasts of the BRITISH ISLES during the Five Years 1866 to 1870.

The following tables have been prepared from the 8 a.m. observations taken daily at the various outports in telegraphic communication with the Meteorological Office.

The readings have been carefully examined, and inquiry has been made in cases of apparent discrepancy, any error which has been discovered being corrected.

As the 2 p.m. observations are taken at only a limited number of stations they have not been included in these averages, in order that the results from all stations may be strictly intercomparable. The observations are uniformly reduced to the temperature of 32° F., and are corrected for altitude above the mean sea level.

The record from Cape Clear, being very incomplete and scarcely trustworthy, is withheld from publication; and for similar reasons those for Weymouth after 1867, and Liverpool after 1869, are not given.

Pembroke	did	not report before	March 1869.
Wick	„	„	September 1869.
Thurso	„	„	February 1870.
Dover	„	„	June 1870.

The returns for the two former stations are therefore given for 1870 only, while the few observations at present received from the two latter are withheld for the present.

TABLE I. contains the average pressure at 8 a.m. for *each* month and year during the five years 1866 to 1870.

TABLE II. gives the mean monthly and annual pressure for the same hour, from the combined observations during the *whole* period, at all stations where the record has been kept continuously.

TABLE I.

Months.	Mean Reading of the Barometer at 8 a.m. for each Station mentioned.														
	Nairn.	Aberdeen.	Leith.	Scarboro'.	Yarmouth.	Ardrossan.	Greencastle.	Holyhead.	Liverpool.	Valencia.	Penzance.	Plymouth.	Weymouth.	Portsmouth.	London.
1866.															
January - -	29·463	29·499	29·568	29·697	29·833	29·576	29·616	29·708	29·752	29·750	29·921	29·891	29·891	29·893	29·867
February -	·474	·455	·523	·597	·678	·533	·563	·610	·660	·712	·805	·783	·757	·748	·721
March - -	·632	·624	·635	·664	·687	·617	·629	·610	·670	·599	·673	·670	·671	·673	·685
April - -	·910	·912	·926	·938	·945	·886	·877	·862	29·931	·767	·879	·885	·905	·912	·933
May - -	·946	·933	·973	·986	·990	·957	·959	·949	30·002	·924	·975	·970	·971	·966	·986
June - -	·869	·867	·898	·922	·956	·872	·862	·867	29·918	·858	29·950	·948	·955	·955	·961
July - -	·914	·873	·910	·909	·927	·916	·933	·913	·945	·949	30·009	·984	·970	·956	·953
August - -	·652	·646	·685	·733	·778	·673	·692	·728	·767	·765	29·888	·860	29·835	·824	·808
September -	29·497	29·510	29·548	29·645	29·737	29·525	29·527	29·605	29·664	·626	29·792	29·780	*—	29·762	29·754
October - -	30·015	30·030	30·056	30·110	30·126	30·037	30·037	30·033	30·103	·992	30·084	30·083	30·090	30·089	30·114
November -	29·708	29·699	29·785	29·844	29·920	29·810	29·867	29·913	29·939	·977	·090	·063	30·040	30·023	29·992
December -	29·616	29·632	29·695	29·813	29·914	29·722	29·745	29·827	29·878	29·877	30·028	30·013	29·998	29·995	29·966
Average for the year -	29·735	29·723	29·767	29·822	29·883	29·760	29·776	29·802	29·852	29·816	29·925	29·911	—	29·900	29·895
1867.															
January - -	29·622	29·595	29·614	29·623	29·641	29·611	29·619	29·588	*—	29·580	29·697	29·698	29·708	29·686	29·674
February -	·728	·737	·825	·933	30·021	·846	·869	·938	29·975	·953	30·115	30·104	30·112	30·086	30·067
March - -	·880	·859	·847	·840	29·810	·814	·795	·738	·798	·657	29·712	29·730	29·772	29·754	29·794
April - -	·578	·570	·624	·701	·773	·646	·675	·739	·757	·800	·940	·915	·911	·864	·830
May - -	29·950	29·943	29·926	29·949	29·922	29·888	29·862	29·846	29·910	29·701	29·853	29·873	29·910	29·890	29·914
June - -	30·030	30·013	30·056	30·094	30·098	30·068	30·093	30·098	30·106	30·135	30·176	30·148	30·156	30·119	30·125
July - -	29·865	29·829	29·846	29·857	29·881	29·861	29·867	29·840	29·873	29·895	29·943	29·922	*—	29·912	29·905
August - -	·819	·825	·862	29·948	29·992	·879	·858	29·915	29·953	29·873	30·019	30·018	·029	30·014	30·011
September -	·882	·890	·939	30·013	30·051	·972	·961	30·004	30·042	30·039	30·131	30·124	30·130	30·112	30·091
October - -	29·715	29·735	29·780	29·848	29·884	29·820	29·820	29·855	29·879	29·928	29·984	29·966	29·972	29·962	29·940
November -	30·225	30·213	30·263	30·270	30·270	30·303	30·313	30·297	30·332	30·299	30·320	30·326	30·331	30·327	30·308
December -	29·878	29·878	29·936	29·954	29·966	30·005	30·009	30·015	30·033	30·135	30·128	30·107	30·096	30·066	30·030
Average for the year -	29·848	29·841	29·877	29·919	29·942	29·893	29·895	29·906	—	29·916	30·002	29·994	—	29·983	29·974

* Record incomplete.

TABLE I.—(*continued.*)

Months.	Mean Reading of the Barometer at 8 a.m. for each Station mentioned.														
	Nairn.	Aberdeen.	Leith.	Scarboro'.	Yarmouth.	Ardrossan.	Greencastle.	Holyhead.	Liverpool.	Valencia.	Roche's Point.	Penzance.	Plymouth.	Portsmouth.	London.
1868.															
January - - -	29·708	29·734	29·766	29·846	29·905	29·787	29·756	29·811	29·870	29·827	29·831	29·964	29·963	29·960	29·928
February - -	·687	·731	·824	·967	30·182	·881	·901	30·030	30·054	30·136	30·129	30·253	30·238	30·207	30·152
March - - -	·657	·701	·762	·864	29·935	·799	·810	29·894	29·933	30·022	29·994	30·095	·080	30·048	30·001
April - - -	·820	·834	·865	·910	29·933	·884	·873	·895	·935	29·941	·932	29·993	·000	29·988	29·966
May - - -	·833	29·885	29·905	29·985	30·035	29·906	29·859	29·915	29·985	29·891	29·895	29·966	·001	30·031	30·032
June - - -	29·967	30·000	30·058	30·121	·151	30·078	30·076	30·111	30·154	30·164	30·157	30·190	·198	·174	·170
July - - -	30·043	30·054	30·079	30·094	30·067	30·091	30·082	30·072	30·108	30·132	30·116	30·103	30·102	30·078	30·081
August - - -	29·769	29·792	29·826	29·878	29·905	29·850	29·832	29·850	29·884	29·914	29·889	29·941	29·937	29·913	29·918
September - -	·910	·909	·906	·901	·901	·905	·862	·821	·886	·793	·775	29·783	29·814	·858	·884
October - - -	·719	·751	·806	29·883	·935	29·833	·829	·903	29·925	·966	·956	30·013	30·022	29·998	29·977
November - -	·951	·969	·999	30·001	·996	30·012	·980	·992	30·026	29·993	·984	30·006	30·032	30·031	30·018
December - -	29·263	29·321	29·322	29·424	29·531	29·325	29·258	29·395	29·422	29·346	29·362	29·492	29·552	29·590	29·565
Average for the year - - -	29·777	29·807	29·843	29·906	29·956	29·863	29·843	29·891	29·932	29·927	29·918	29·983	29·995	29·990	29·974
1869.															
January - - -	29·710	29·770	29·807	29·920	30·025	29·831	29·740	29·846	29·915	29·747	29·818	29·941	30·000	30·041	30·029
February - -	·579	·639	·705	·817	29·915	·735	·728	·856	·877	·902	·911	30·007	30·044	30·018	29·974
March - - -	·891	·880	·903	·851	29·795	·930	·943	·902	29·899	·992	·926	29·887	29·889	29·811	29·820
April - - -	·897	·919	·952	·986	30·008	·978	·943	·976	30·001	·948	·962	·998	30·032	30·005	30·012
May - - -	29·925	29·919	29·916	29·882	29·842	29·921	29·896	29·823	*—	29·811	29·787	29·760	29·798	29·801	29·829
June - - -	30·053	30·041	30·062	30·068	30·078	30·097	30·113	30·104	·080	30·167	30·138	30·116	30·132	30·102	30·100
July - - -	29·926	29·955	29·982	·065	·111	·014	29·988	·057	·065	·063	·065	·089	·126	·112	·115
August - - -	30·065	30·071	30·105	30·114	30·135	30·139	30·152	30·157	30·130	30·214	30·181	30·170	30·186	30·150	30·154
September - -	29·545	29·585	29·607	29·698	29·798	29·629	29·593	29·701	29·702	29·703	29·711	29·804	29·851	29·838	29·824
October - - -	·952	·942	·982	·978	30·005	30·014	30·030	30·046	30·015	30·006	30·082	30·075	30·089	30·053	30·044
November - -	·678	·685	·761	·817	29·881	29·818	29·850	29·924	29·886	30·027	30·001	30·042	30·037	29·975	29·942
December - -	29·668	29·694	29·709	29·748	29·792	29·745	29·731	29·756	29·760	29·804	29·795	29·829	29·818	29·808	29·802
Average for the year - - -	29·824	29·842	29·874	29·912	29·949	29·904	29·892	29·929	—	29·949	29·948	29·977	30·000	29·976	29·970

Weymouth Records for 1868 very incomplete, and therefore omitted. The reports ceased February 28, 1869.

* Record incomplete.

Table I.—(*continued.*)

Months.	Mean Reading of the Barometer at 8 a.m. for each Station mentioned.															
	Wick.	Nairn.	Aberdeen.	Leith.	Scarboro'.	Yarmouth.	Ardrossan.	Greencastle.	Holyhead.	Valencia.	Roche's Point.	Pembroke.	Penzance.	Plymouth.	Portsmouth.	London.
1870.																
January -	29·785	29·765	29·845	29·865	29·919	29·992	29·870	29·840	29·877	29·868	29·889	29·899	29·971	29·979	29·988	29·987
February -	29·848	29·867	29·888	29·874	29·892	29·924	29·869	29·850	29·839	29·773	29·770	29·790	29·817	29·846	29·853	29·885
March -	30·015	30·076	30·044	30·068	30·034	30·029	30·085	30·089	30·075	30·098	30·070	30·045	30·075	30·070	30·036	30·039
April -	29·942	29·962	30·000	30·049	·113	·172	30·064	30·064	·138	30·155	30·146	·161	·208	·205	·176	·186
May -	·873	·880	29·917	29·925	·008	·067	29·951	29·932	·000	29·976	29·986	·020	·086	·091	·079	·084
June -	·976	·998	30·012	30·026	30·083	30·110	30·075	30·089	·133	30·199	30·169	·151	·212	·191	30·140	·134
July -	29·914	29·921	29·940	29·936	29·979	29·996	29·979	29·968	·009	·040	·016	·003	·050	·033	29·993	30·004
August -	30·006	30·011	30·014	·996	29·986	29·949	30·047	30·043	·021	·054	·031	·002	·041	·018	30·007	29·984
September -	29·878	29·894	29·926	·927	30·016	30·071	29·999	29·970	30·009	30·015	30·014	30·024	30·090	30·075	30·078	30·086
October -	·566	·577	·598	·582	29·694	29·752	·628	·598	29·659	29·707	29·702	29·697	29·816	29·875	29·784	29·754
November -	·680	·708	·712	·720	·761	·797	·739	·736	·750	·779	·769	·748	·823	·811	·826	·815
December -	29·935	29·948	29·950	29·943	29·925	29·917	29·961	29·949	29·926	29·908	29·902	29·893	29·936	29·909	29·922	29·919
Average for the year -	29·868	29·884	29·904	29·909	29·951	29·981	29·939	29·927	29·953	29·964	29·955	29·953	30·010	30·009	29·990	29·990

Liverpool record very imperfect, therefore omitted.

TABLE II.—Mean Monthly and Annual Barometric Pressure for the Five Years 1866 to 1870.

Months.	Names of Stations.													
	Nairn.	Aberdeen.	Leith.	Scarboro'.	Yarmouth.	Ardrossan.	Greencastle.	Holyhead.	Valencia.	Roche's Point (for 3 years only).	Penzance.	Plymouth.	Portsmouth.	London.
January - -	29·654	29·689	29·724	29·801	29·879	29·735	29·714	29·766	29·754	29·846	29·899	29·906	29·914	29·897
February -	·667	·690	·750	·841	·944	·773	·782	·855	·895	·937	·999	30·003	·982	·960
March - -	·827	·822	·843	·851	·852	·849	·853	·844	·874	29·997	29·888	29·888	·864	·868
April - -	·833	·847	·883	·930	·966	·892	·886	·922	·922	30·013	30·004	30·007	·989	·991
May - -	·907	·919	29·929	29·962	29·971	29·925	29·902	29·907	29·861	29·889	29·928	29·947	29·953	29·969
June - -	·983	·987	30·020	30·058	30·079	30·038	30·047	30·063	30·105	30·155	30·129	30·123	30·098	30·098
July - -	·934	·930	29·951	29·981	29·996	29·972	29·968	29·978	30·016	·066	·039	·033	30·010	30·012
August - -	·863	·870	·895	·932	·952	·918	·915	·934	29·964	30·034	30·012	30·004	29·982	29·975
September -	·746	·764	·785	·855	·912	·806	·783	·828	·835	29·833	29·920	29·929	·930	·928
October - -	·796	·811	·841	·903	·940	·866	·863	·899	29·920	·913	29·994	30·007	29·977	29·966
November -	·854	·856	·906	·939	·973	·936	·949	·975	30·015	·918	30·056	30·054	30·036	30·015
December -	29·675	29·695	29·721	29·773	29·824	29·752	29·738	29·784	29·814	29·686	29·883	29·878	29·876	29·856
Average for the year -	29·811	29·823	29·854	29·902	29·941	29·872	29·867	29·896	29·915	29·940	29·979	29·982	29·968	29·961

APPENDIX III.

RAINFALL at the TELEGRAPHIC REPORTING STATIONS on the COASTS of the BRITISH ISLES for the Five Years 1866-1870.

The following tables, which have been compiled principally by Mr. F. Gaster, give the total amount of rain measured in each month and year during the five years ending December 31, 1870, together with the monthly and yearly averages, and a few other details of interest.

Table I. shows the totals for each month at all the stations excepting a few where, either from defective exposure of the gauge, or from incompleteness of the record, the returns must be held to be comparatively worthless.

In preparing this table, the rain, which is invariably measured at 8 a.m. daily, has been taken to refer to the previous day, in accordance with the generally received practice. The values have been carefully examined, and inquiry has been made in the case of apparent discrepancies, so that errors have been, as far as possible, removed.

Table II. gives the mean monthly and annual values for the five years at all the stations, 14 in number, at which the record has been kept continuously, together with the per-centage of the mean annual fall which was measured in each month.

Table III. gives all the falls of 1 in. (and upwards) in 24 hours which have been reported during the years 1869 and 1870. This collection was confined to these two years, because until 1869 the arrangement adopted by the late Admiral FitzRoy, of reporting in one quantity the rain which fell between 8 a.m. on Saturday and 8 a.m. on Monday, was in force during at least some months in the year, the observations being thus rendered useless for the purpose of determining the daily fall on Saturdays or Sundays.

In the year 1869 the observer at Yarmouth reported more than an inch of rain on several occasions. These figures must be accepted with hesitation, as there is some uncertainty as to the gauge having been examined every day during that year as it should have been. The largest fall in 24 hours reported during the five years was from Weymouth on the 10th May 1867, when 4·16 in. fell during heavy thunderstorms.

The following are the details of the height of the gauges above the ground and above sea level, with some notes as to their exposure, &c.

Stations.	Height of Rim of Gauge.			Remarks.
	Above Mean Sea Level.	Above the Ground.		
	Ft.	Ft.	Ins.	
Thurso	25	1	9	
Wick	20	1	9	
Nairn	44	1	2	
Aberdeen	135	1	2	
Leith	36 21	16 1	0 2	On the roof of an office on the pier till early in 1868, then placed on ground in a garden.
Scarborough	130	1	2	
Yarmouth	20	1	2	Not *very* well exposed.
Ardrossan	13	1	2	
Greencastle	18	1	2	
Holyhead	27 44	6 1	0 2	On a wall in the railway station until end of January 1870; then shifted to new position on ground, but exposure not *very* good.
Valencia	120 35	1 5	2 0	Till December 1867, then shifted. On a wall.
Roche's Point	23	1	9	
Pembroke (St. Ann's Head)	125	1	2	
Penzance	30	1	2	
Plymouth	?	?		Gauge was several times removed. Position never *very* good.
Weymouth	10	1	2	
Portsmouth	21 16	6 1	0 2	On a low wall till 1870, when it was shifted. Position not good after the change till 1st December 1870, when it was greatly improved.
Dover	25	1	9	
London	Various	1	6	The London rainfall is the mean of measurements made from three gauges in different parts of the suburbs.

Note.—The gauges at Plymouth and Portsmouth are now more satisfactorily situated.

TABLE I.—MONTHLY and ANNUAL RAINFALL at BRITISH and IRISH STATIONS.

1866.

MONTHS.	MONTHLY RAINFALL AT EACH STATION.								
	Nairn.	Aberdeen.	Leith.	Scarboro'.	Yarmouth.	Ardrossan.	Green-castle.	Holyhead.	Liverpool.
January - -	1·96	2·40	1·71	2·33	4·60	6·67	5·86	5·49	2·24
February - -	1·70	2·43	2·38	1·97	6·57	4·92	4·53	2·39	2·49
March - -	1·24	2·27	1·31	2·24	1·88	2·02	2·27	1·87	1·40
April - -	0·80	1·01	1·02	2·34	1·95	1·53	1·14	0·92	0·96
May - - -	1·61	1·64	1·66	0·87	2·42	1·62	1·09	1·71	1·11
June - -	0·47	1·26	0·81	2·82	3·58	2·50	2·14	3·13	2·73
July - -	2·80	2·95	3·07	4·76	2·77	2·27	2·46	0·92	2·62
August - -	3·02	1·78	2·81	3·91	1·36	6·18	3·96	3·34	2·93
September - -	2·25	2·79	2·10	3·40	4·84	5·23	4·03	4·97	4·36
October - -	1·69	2·40	0·64	2·64	*0·44	3·06	2·20	2·55	1·36
November - -	1·80	1·53	1·48	2·68	4·35	4·56	5·93	2·79	3·84
December - -	4·05	2·88	1·51	2·09	3·26	5·47	5·27	3·54	2·22
Total for the year -	23·39	25·34	20·50	32·05	38·02	46·03	40·88	33·62	28·26

* Only 16 hours of rain at Yarmouth during the month.

(*continued.*)

MONTHS.	MONTHLY RAINFALL AT EACH STATION.					
	Valencia.	Penzance.	Plymouth.	Weymouth.	Portsmouth.	London.
January - -	7·90	7·91	7·18	6·26	6·70	3·93
February - -	4·15	6·65	4·68	3·71	4·44	3·71
March - -	5·65	4·53	3·67	1·77	1·86	1·66
April - -	5·23	5·09	2·26	2·04	1·64	2·11
May - - -	2·40	2·40	3·00	1·18	1·01	2·18
June - -	2·80	1·93	1·95	1·93	2·19	3·35
July - -	1·86	0·88	1·69	1·02	1·40	1·52
August - -	5·49	4·99	4·85	2·04	2·55	2·69
September - -	5·56	7·09	9·54	*—	5·86	3·51
October - -	3·54	2·04	2·80	2·05	1·70	2·25
November - -	3·98	3·23	3·06	2·00	1·75	1·49
December - -	5·92	4·97	4·29	2·05	2·03	2·22
Total for the year -	54·48	51·71	48·97	—	33·13	30·62

* *Weymouth* record incomplete.

TABLE I.—MONTHLY and ANNUAL RAINFALL at BRITISH and IRISH STATIONS—*continued.*

1867.

MONTHS.	MONTHLY RAINFALL AT EACH STATION.								
	Nairn.	Aberdeen.	Leith.	Scarboro'.	Yarmouth.	Ardrossan.	Green-castle.	Holyhead.	Liverpool.
January - -	4·46	5·72	2·53	4·02	6·26	3·83	4·91	2·89	—
February - -	1·56	1·24	1·23	0·76	1·04	2·75	3·40	1·93	1·27
March - -	1·14	2·38	0·61	1·70	0·82	0·82	1·79	1·33	0·91
April - -	2·45	3·16	2·43	2·02	2·24	5·24	4·75	3·14	2·34
May - - -	1·66	2·71	3·14	2·30	2·85	2·73	2·35	1·96	0·97
June - -	2·01	1·32	2·26	1·85	1·31	1·83	2·03	0·63	0·77
July - -	2·06	3·34	4·22	4·15	2·84	3·58	5·69	1·95	3·46
August - -	2·28	3·35	1·95	2·35	*0·72	2·53	2·15	2·23	1·33
September - -	1·66	2·06	1·56	2·38	1·93	2·63	2·20	2·57	1·39
October - -	3·40	2·12	1·51	3·12	3·69	4·57	7·74	5·33	4·13
November - -	0·74	0·81	0·12	0·91	1·27	1·53	1·80	1·33	1·89
December - -	2·82	2·74	1·17	2·92	3·38	2·88	4·11	4·73	2·93
Total for the year -	26·24	30·95	22·73	28·48	28·35	34·92	42·92	30·02	—

* Only one day's rain at Yarmouth.

(*continued.*)

MONTHS.	MONTHLY RAINFALL AT EACH STATION.						
	Valencia.	Roche's Point.	Penzance.	Plymouth.	Weymouth.	Portsmouth.	London.
January - -	5·59	7·10	5·89	5·64	4·57	3·00	2·68
February - -	4·73	*—	4·18	3·10	2·28	1·84	1·36
March - -	3·61	—	4·51	5·61	5·07	2·26	2·37
April - -	4·19	—	3·28	3·55	1·35	1·71	2·10
May - - -	3·29	—	3·62	3·17	†6·93	1·55	2·13
June - -	1·13	0·75	0·51	0·53	0·85	1·73	1·31
July - -	3·58	5·95	4·73	4·40	‡—	3·64	4·02
August - -	5·04	7·00	1·22	1·21	1·36	2·36	2·33
September - -	5·24	4·00	1·66	3·31	1·22	2·06	2·15
October - -	8·82	6·53	5·19	4·28	2·11	3·26	1·86
November - -	2·01	1·65	1·76	2·41	§0·19	0·43	0·64
December - -	4·51	1·77	2·84	2·78	2·00	1·06	1·51
Total for the year -	51·74	—	39·39	39·99	—	24·90	24·46

* *Roche's Point* suspended for four months. † *Tremendous* rain at Weymouth on the 10th (4·16 ins.). ‡ *Weymouth* record incomplete.
§ In the W. and S.W. of England the greater part of the rain fell on the last day of the month, and did not affect Weymouth.

TABLE I.—MONTHLY and ANNUAL RAINFALL at BRITISH and IRISH STATIONS—*continued.*

1868.

MONTHS.	MONTHLY RAINFALL AT EACH STATION.								
	Nairn.	Aberdeen.	Leith.	Scarboro'.	Yarmouth.	Ardrossan.	Green-castle.	Holyhead.	Liverpool.
January - -	4·85	3·10	2·32	1·81	2·68	6·27	3·96	4·16	1·75
February - -	3·46	1·79	1·20	1·13	1·45	4·27	3·43	2·73	2·10
March - -	1·80	1·91	0·97	1·25	2·36	4·88	5·20	2·96	2·72
April - -	1·66	2·53	2·66	2·08	2·03	2·95	1·91	1·33	1·75
May - -	1·52	1·24	1·86	1·06	0·57	2·72	1·97	1·33	1·69
June - -	0·72	0·66	0·27	0·36	0·52	1·18	1·07	0·19	0·15
July - -	0·50	0·73	0·36	0·75	0·35	0·55	0·37	0·78	0·37
August - -	5·37	6·76	3·84	2·25	2·27	6·53	5·28	2·78	2·71
September - -	2·80	3·99	2·53	2·43	2·24	1·98	2·04	2·39	1·73
October - -	1·74	1·95	1·33	3·05	2·41	4·84	4·01	2·94	2·76
November - -	1·09	1·59	1·11	2·19	2·35	3·61	4·06	1·84	2·04
December* - -	1·73	5·88	2·93	5·56	4·92	6·66	3·55	7·43	6·46
Totals for the year -	27·24	32·13	21·38	23·92	24·15	46·44	36·85	30·86	26·23

* Very wet month, except at Nairn, where the fall is much below the average.

(*continued.*)

MONTHS.	MONTHLY RAINFALL AT EACH STATION.					
	Valencia.	Roche's Point.	Penzance.	Plymouth.	Portsmouth.	London.
January - -	8·49	7·17	6·40	5·52	3·41	3·63
February - -	4·74	4·17	2·76	2·24	1·19	1·03
March - -	5·75	7·01	2·15	2·57	1·47	1·07
April - -	3·39	4·39	3·09	3·54	2·21	1·37
May - -	3·48	3·77	1·69	2·06	1·05	1·24
June - -	1·66	1·90	0·83	0·86	0·45	0·67
July - -	2·74	1·11	0·78	0·54	1·07	0·95
August - -	2·64	3·80	3·79	4·30	2·84	2·43
September - -	3·15	7·81	2·78	5·43	2·59	2·18
October - -	6·35	4·39	5·60	4·81	3·00	2·31
November - -	7·15	4·50	4·57	4·36	1·31	0·98
December - -	9·70	10·35	7·17	8·62	7·28	4·57
Totals for the year -	59·24	60·37	41·61	44·85	27·87	22·43

Observer at *Weymouth* died in May. Record too incomplete for publication.

TABLE I.—MONTHLY and ANNUAL RAINFALL at BRITISH and IRISH STATIONS—*continued.*

1869.

MONTHS.	MONTHLY RAINFALL AT EACH STATION.								
	Nairn.	Aberdeen.	Leith.	Scarboro'.	Yarmouth.	Ardrossan.	Green-castle.	Holyhead.	Liverpool.
January - -	1·31	4·15	2·44	2·10	1·87	4·84	2·64	5·36	2·65
February - -	2·31	1·28	2·38	1·54	2·39	4·78	4·77	3·05	2·14
March - -	1·29	1·70	0·52	2·52	4·50	1·03	2·34	1·97	1·19
April - -	1·99	2·35	1·05	1·77	0·68	1·60	2·28	1·81	1·97
May - -	1·55	1·51	1·51	3·48	2·28	0·79	2·04	2·76	*
June† - -	1·38	2·29	1·65	1·01	1·89	1·81	2·51	0·87	1·05
July - -	0·66	0·94	0·83	0·95	0·63	2·19	2·98	0·77	0·70
August - -	1·89	1·23	0·67	1·37	2·58	0·98	2·94	1·13	2·01
September - -	3·76	4·79	4·31	3·73	2·95	6·85	4·86	6·55	6·04
October - -	2·89	6·13	1·44	3·55	4·14	1·68	3·18	3·08	2·64
November - -	2·43	1·80	1·14	3·17	2·90	5·27	7·48	2·60	3·39
December - -	1·90	2·50	0·77	4·62	5·73	5·49	4·85	3·23	2·51
Totals for the year -	23·36	30·67	18·71	29·81	32·54	37·31	42·87	33·18	—

* *Liverpool* not working all the month. † *Very* dry month.

(*continued.*)

MONTHS.	MONTHLY RAINFALL AT EACH STATION.						
	Valencia.	Roche's Point.	Pembroke.	Penzance.	Plymouth.	Portsmouth.	London.
January - -	8·54	9·92	—	6·50	5·30	3·47	2·48
February - -	4·30	4·21	—	3·97	4·30	2·41	2·40
March - -	3·28	3·05	1·99	2·95	2·95	2·15	1·62
April - -	4·49	2·07	1·30	1·64	1·38	1·15	1·15
May - -	2·58	5·94	3·79	4·36	5·90	4·66	3·24
June - -	0·91	0·32	0·29	0·59	0·21	2·06	1·15
July - -	5·22	2·16	1·24	1·81	1·02	1·80	0·63
August - -	2·12	1·07	1·41	0·83	0·62	0·80	1·42
September - -	8·47	5·30	5·28	4·83	4·38	5·04	3·40
October - -	2·17	0·67	2·77	3·13	1·99	1·81	1·76
November - -	4·81	2·33	3·04	5·40	2·92	1·62	2·33
December - -	8·56	5·47	3·79	5·49	4·25	3·50	2·63
Totals for the year -	55·45	42·51	—	41·50	35·22	30·47	24·21

‡ *Weymouth* ceased reporting, and *Pembroke* began.

TABLE I.—MONTHLY and ANNUAL RAINFALL at BRITISH and IRISH STATIONS—*continued.*

1870.

MONTHS.	MONTHLY RAINFALL AT EACH STATION.								
	Wick.	Nairn.	Aberdeen.	Leith.	Scarboro'.	Yarmouth.	Ardrossan.	Green-castle.	Holyhead.
January - - -	2·15	1·21	1·52	1·51	1·46	1·29	4·13	2·44	2·79
February - -	1·79	0·90	2·87	2·05	1·57	1·32	3·28	2·05	3·06
March - - -	1·34	0·57	0·68	1·57	1·33	1·62	1·32	1·34	2·74
April - - -	1·97	1·38	1·33	0·23	0·80	0·87	1·59	1·84	1·19
May - - -	1·58	1·61	1·63	1·00	0·95	1·37	4·05	2·25	2·13
June - - -	0·53	1·38	0·86	2·00	2·03	1·70	1·71	2·59	0·94
July - - -	0·93	1·53	3·52	1·30	0·29	2·73	3·56	1·57	0·37
August - - -	0·59	1·70	0·86	0·89	2·28	2·76	2·83	2·14	0·89
September - -	2·80	2·77	2·14	1·67	1·24	1·45	3·53	3·64	1·85
October - - -	2·08	1·52	3·02	1·42	3·70	4·15	5·55	7·69	6·77
November - -	2·71	1·99	2·66	0·60	3·13	0·97	2·14	2·90	4·05
December - -	5·72	2·79	4·64	1·63	5·29	5·76	2·22	2·77	2·68
Total for the year -	24.19	19·35	25.73	15·87	24.07	25.99	35·91	33·22	29·46

(*continued.*)

MONTHS.	MONTHLY RAINFALL AT EACH STATION.						
	Valencia.	Roche's Point.	Pembroke.	Penzance.	Plymouth.	Portsmouth.	London.
January - - -	6·16	4·34	2·92	3·46	2·96	1·43	1·20
February - -	4·60	3·25	2·67	3·41	3·92	2·03	1·02
March - - -	1·94	2·86	2·93	3·40	2·58	1·38	2·21
April - - -	3·61	1·41	0·59	0·16	0·14	0·23	0·45
May - - -	4·50	5·52	2·34	1·82	1·62	1·22	0·60
June - - -	0·61	1·04	0·57	0·43	0·28	0·24	0·78
July - - -	2·05	1·23	1·53	1·74	1·82	1·10	1·70
August - - -	2·62	1·84	1·67	1·92	1·52	1·51	2·74
September - -	4·25	3·01	1·61	1·94	1·94	1·47	1·83
October - - -	10·03	5·61	7·71	6·17	3·68	2·80	3·43
November - -	4·97	4·06	5·33	5·27	2·29	1·63	1·82
December - -	2·59	3·64	2·01	3·26	2·98	2·47	2·99
Total for the year -	47·93	37·81	31·88	32.98	25·73	17·51	20·77

Liverpool record incomplete and unreliable.

TABLE II.—MEAN MONTHLY and ANNUAL RAINFALL at 14 BRITISH STATIONS for the Five Years 1866 to 1870; with the PER-CENTAGE of the MEAN ANNUAL FALL which was collected in each Month.

MONTHS.	NAIRN.		ABERDEEN.		LEITH.		SCARBOROUGH.	
	Rainfall in Inches.	Equivalent Per-centage.	Rainfall in Inches.	Equivalent Per-centage.	Rainfall in Inches.	Equivalent Per-centage.	Rainfall in Inches.	Equivalent Per-centage.
January - - -	2·76	11·5	3·38	11·7	2·10	10·6	2·34	8·5
February - - -	1·99	8·3	1·92	6·6	1·85	9·3	1·39	5·0
March - - -	1·21	5·1	1·79	6·2	1·00	5·0	1·81	6·5
April - - -	1·68	7·0	2·07	7·1	1·48	7·5	1·80	6·5
May - - -	1·59	6·6	1·74	6·0	1·83	9·2	1·73	6·3
June - - -	1·19	5·0	1·28	4·4	1·40	7·1	1·61	5·8
July - - -	1·51	6·3	2·30	7·9	1·96	9·9	2·18	7·9
August - - -	2·85	11·9	2·80	9·7	2·03	10·2	2·44	8·8
September - - -	2·65	11·1	3·15	10·9	2·43	12·2	2·64	9·5
October - - -	2·25	9·4	3·12	10·8	1·27	6·4	3·21	11·6
November - - -	1·61	6·7	1·68	5·4	0·89	4·5	2·42	8·8
December - - -	2·66	11·1	3·73	12·9	1·60	8·1	4·10	14·8
Totals - -	23·93	100·0	28·96	100·0	19·84	100·0	27·67	100·0

(*continued.*)

MONTHS.	YARMOUTH.		ARDROSSAN.		GREENCASTLE.		HOLYHEAD.	
	Rainfall in Inches.	Equivalent Per-centage.	Rainfall in Inches.	Equivalent Per-centage.	Rainfall in Inches.	Equivalent Per-centage.	Rainfall in Inches.	Equivalent Per-centage.
January - - -	3·34	11·2	5·15	12·8	3·96	10·1	4·14	13·1
February - - -	2·55	8·6	4·00	10·0	3·64	9·3	2·63	8·3
March - - -	2·24	7·5	2·02	5·0	2·59	6·6	2·18	6·9
April - - -	1·55	5·2	2·58	6·5	2·38	6·0	1·68	5·4
May - - -	1·90	6·4	2·38	5·9	1·94	4·9	1·98	6·3
June - - -	1·80	6·0	1·81	4·5	2·07	5·3	1·15	3·7
July - - -	1·86	6·2	2·43	6·1	2·62	6·7	0·96	3·1
August - - -	1·94	6·5	3·81	9·5	3·29	8·4	2·07	6·6
September - - -	2·68	9·0	4·04	10·1	3·35	8·5	3·67	11·7
October - - -	2·97	10·0	3·94	9·8	4·96	12·6	4·13	13·1
November - - -	2·37	8·0	3·42	8·5	4·43	11·2	2·52	8·0
December - - -	4·61	15·4	4·54	11·3	4·11	10·4	4·32	13·8
Totals - -	29·81	100·0	40·12	100·0	39·34	100·0	31·43	100·0

TABLE II.—MEAN MONTHLY and ANNUAL RAINFALL, &c.—*continued.*

MONTHS.	VALENCIA.		ROCHE'S POINT. (For three years only).		PENZANCE.		PLYMOUTH.	
	Rainfall in Inches.	Equivalent Percentage.	Rainfall in Inches.	Equivalent Percentage.	Rainfall in Inches.	Equivalent Percentage.	Rainfall in Inches.	Equivalent Percentage.
January - - -	7·34	13·7	7·14	15·2	6·03	14·6	5·32	13·7
February - - -	4·50	8·4	3·87	8·3	4·19	10·1	3·65	9·4
March - - -	4·04	7·5	4·31	9·2	3·51	8·4	3·48	8·9
April - - -	4·18	7·8	2·62	5·6	2·65	6·4	2·17	5·6
May - - -	3·25	6·0	5·08	10·8	2·78	6·7	3·15	8·1
June - - -	1·42	2·6	1·09	2·3	0·86	2·1	0·77	2·0
July - - -	3·09	5·8	1·50	3·2	1·99	4·8	1·89	4·9
August - - -	3·58	6·7	2·24	4·8	2·55	6·1	2·50	6·4
September - - -	5·33	9·9	5·37	11·5	3·66	8·8	4·92	12·6
October - - -	6·18	11·5	3·56	7·6	4·43	10·7	3·51	9·0
November - - -	4·58	8·5	3·63	7·7	4·04	9·8	3·01	7·7
December - - -	6·26	11·6	6·49	13·8	4·75	11·5	4·58	11·7
Totals - -	53·77	100·0	46·90	100·0	41·44	100·0	38·95	100·0

(*continued.*)

MONTHS.	PORTSMOUTH.		LONDON.	
	Rainfall in Inches.	Equivalent Percentage.	Rainfall in Inches.	Equivalent Percentage.
January - - -	3·61	13·5	2·79	11·4
February - - -	2·38	8·9	1·90	7·8
March - - -	1·83	6·8	1·79	7·3
April - - -	1·39	5·2	1·44	5·9
May - - -	1·90	7·1	1·88	7·7
June - - -	1·33	5·0	1·45	5·9
July - - -	1·80	6·7	1·77	7·2
August - - -	2·01	7·5	2·32	9·5
September - - -	3·40	12·7	2·61	10·6
October - - -	2·51	9·4	2·32	9·5
November - - -	1·35	5·0	1·45	5·9
December - - -	3·27	12·2	2·78	11·3
Totals - -	26·78	100·0	24·50	100·0

TABLE III.—Falls of 1 in., or more, in 24 Hours.

Date.	Station.	Amount of Fall.			Remarks.
		Inches.	Per-centage of Mean for the Month.	Per-centage of Mean for the Year.	
1869.					
January 19	Valencia - -	1·05	14·3	1·95	
February 7	Valencia - -	1·01	22·4	1·88	
„ 12	Yarmouth - -	1·12	43·9	3·76	
March 20	Yarmouth - -	1·53	68·3	5·13	
„ 27	Yarmouth - -	1·01	45·1	3·39	
April 16	Nairn - -	1·49	88·7	6·23	
May 3	Penzance - -	1·36	48·9	3·28	
„ „	Plymouth - -	1·17	37·1	3·00	
„ 15	Roche's Point	1·10	21·7	2·35	
„ 16	Roche's Point -	1·00	19·7	2·13	N.B.—No fall of 1 in. was reported in the June of 1869.
July 6	Greencastle - -	1·01	38·6	2·57	
„ 25	Valencia - -	1·85	59·9	3·44	
August 1	Greencastle - -	1·50	45·6	3·81	
September 5	Scarborough -	1·14	43·2	4·12	
„ 11	Holyhead - -	1·27	34·6	4·04	
„ „	Pembroke - -	1·05	?	?	
„ 12	Aberdeen - -	1·69	50·5	5·84	
„ „	Yarmouth - -	1·08	40·3	3·62	
„ 27	Valencia - -	1·23	23·1	2·29	
„ 28	Ardrossan - -	1·06	26·2	2·64	
„ 29	Liverpool - -	1·63	?	?	
„ 30	Valencia - -	1·03	19·3	1·92	
„ „	Portsmouth - -	1·03	30·3	3·85	
October 15	Aberdeen - -	1·40	44·9	4·83	Total, 3·2 ins. in two days, or 102·6 per cent. of the average for the month.
„ 16	Aberdeen - -	1·80	57·7	6·22	
„ 19	Penzance - -	1·00	22·6	2·41	
„ 27	Scarborough -	1·08	33·6	3·90	
„ 28	Yarmouth - -	1·33	44·8	4·46	
November 13	Ardrossan - -	1·38	40·4	3·44	
„ „	Greencastle - -	1·05	23·7	2·67	
„ 27	Penzance - -	1·01	25·0	2·44	

Table III.—*continued.*

Date.		Station.	Amount of Fall.			Remarks.
			Inches.	Per-centage of Mean for the Month.	Per-centage of Mean for the Year.	
1869.						
November	27	London	1·00	69·0	4·08	
„	29	Penzance	1·25	30·9	3·01	
December	10	Ardrossan	1·33	29·3	3·32	
„	16	Pembroke	1·12	?	?	
„	29	Valencia	2·05	32·7	3·81	
1870.						
January	30	Valencia	1·25	17·0	2·32	
February	6	Penzance	1·01	24·1	2·43	
„	„	Plymouth	1·34	36·7	3·44	
„	27	Ardrossan	1·05	26·3	2·62	
March	2	Pembroke	1·00	?	?	
„	„	Penzance	1·04	29·6	2·51	
May	11	Pembroke	1·04	?	?	
„	„	Plymouth	1·14	36·2	2·93	
July	9	Plymouth	1·12	59·3	2·11	
„	11	Aberdeen	1·88	81·7	6·49	
August	6	Valencia	1·16	32·4	2·16	
September	1	Valencia	1·45	27·2	2·70	
„	13	Nairn	1·10	41·5	4·60	
October	12	Greencastle	1·00	20·2	2·54	
„	15	Valencia	2·01	32·5	3·74	
„	„	Roche's Point	1·02	28·7	2·17	
„	„	Pembroke	1·21	?	?	
„	„	Holyhead	1·03	24·9	3·28	
„	19	Greencastle	1·11	22·4	2·82	
„	22	Valencia	1·06	27·2	1·97	
„	„	Roche's Point	1·02	28·7	2·17	
„	26	Valencia	1·25	20·2	2·32	
November	12	Scarborough	1·13	46·7	4·08	
December	11	Roche's Point	1·58	24·3	3·37	
„	19	Aberdeen	1·10	29·5	3·80	
„	23	Thurso	1·05	?	?	

APPENDIX IV.

BESSEL'S PAPER

On the DETERMINATION of the LAW of a PERIODICAL PHENOMENON.

Translated from Astronomische Nachrichten, 136, for May 1828.

I.

It frequently happens in Nature that phenomena which depend on a variable quantity exhibit a period, at the conclusion of which they constantly recur in the same order and magnitude. In so far as they are regular, or are not liable to sudden changes, the condition that they are periodic gives the form of the mathematical expression which represents them: this fact renders it possible for us to ascertain their character from a series of observations more completely than we can do with other phenomena the law of whose march is unknown to us.

Let, for instance, k represent a period after the completion of which the phenomenon y constantly recurs, and let x be the variable quantity on which it depends. The given condition is that y remains constant for values of x, which are increased or diminished by k, $2k$, $3k$, &c. This is represented by the equation—

$$y = u + u_1 \sin\left(U_1 + \frac{2\pi x}{k}\right) + u_2 \sin\left(U_2 + \frac{4\pi x}{k}\right) + \&c. \qquad (1.)$$

in which u, u_1, u_2, and U_1, U_2, &c. are constants, 2π being as usual 360°.

The tangents and secants give periodic forms also, as well as the sines, but they do not belong to phenomena whose march is free from interruption. These latter may always be represented by an expression of the above form. If, then, we can determine u, u_1, u_2, &c., U_1, U_2, &c., from a series of observations, we obtain thereby the mathematical expression of the phenomenon; and when it is necessary to select this so as to correspond with the observations, it can be so selected as to give the development which follows from the observations, which is in fact nothing else but the result of the observations in the concisest possible form.

Hence it follows that, by the determination of the *development* which belongs to a phenomenon, we meet its theory half way. Thus, *e.g.*, the observed solar longitudes, if developed in this way according to the yearly period, would give a formula from which, if Kepler's discovery were yet to be made, we could discover the elliptic motion much more easily than from the observations themselves. Meteorology presents us with other periodic phenomena; the yearly and daily march of temperature, the daily oscillation of the barometer, the influence of the wind on the readings of the meteorological instruments, are phenomena of this nature; and if we calculate from the observations the formulæ corresponding to them, they can be brought into the shortest and most complete form, so that we can determine what the theory has to explain more immediately from them than from the observations themselves, or from the curves by means of which we are accustomed to represent phenomena whose laws are unknown. In the last named of the above cases the period is not determined by the time but by the circumference of the horizon; but it is unnecessary to remark that the quantity in which the period is expressed is immaterial.

The determination of the unknown quantities u, u_1, u_2, &c., U_1, U_2, &c. becomes very simple and elegant when the empirically determined values of y, on which the development is to be based, belong to values of x, which form an arithmetical progression and occupy the entire period. This I have shown in the first part of my observations, but still earlier (Jena Literatur-Zeitung, 1814, No. 231) I had given an application of the method to the daily variations of the barometer which have been observed by von Humboldt and Horner. There is something more to add to it, so I take up the matter anew.

II.

If nothing is known of the law of y, except the condition of its periodical recurrence contained in equation (1.), the number of the unknown quantities u, u_1, u_2, &c., U_1, U_2, &c. is unlimited; you can determine as many of them as you know values of y, and they can always be fully represented thereby. This determination is obtained by solution of the equations—

$$\begin{aligned}
\alpha &= p + p_1 \cos z + q_1 \sin z + p_2 \cos 2z + q_2 \sin 2z + \&c.\\
\alpha_1 &= p + p_1 \cos z_1 + q_1 \sin z_1 + p_2 \cos 2z_1 + q_2 \sin 2z_1 + \&c.\\
\alpha_2 &= p + p_1 \cos z_2 + q_1 \sin z_2 + p_2 \cos 2z_2 + q_2 \sin 2z_2 + \&c.\\
&\qquad \&c. \qquad \&c. \qquad \&c.
\end{aligned}$$

In which α, α_1, α_2, are the known values of y,

and z, z_1, z_2, " " of $\frac{2\pi x}{k}$ to which they belong.

p, p_1, p_2, &c., q_1, q_2, &c. are put for u, $u_1 \sin U_1$, $u_2 \sin U_2$, &c., $u_1 \cos U_1$, $u_2 \cos U_2$, &c.

If it be not wished to represent α, α_1, α_2, &c. completely, but only to determine a certain number of the first terms of the expression in as advantageous a way as possible, we should employ the method of least squares to discover those terms.

I shall now take z, z_1, z_2, &c. in arithmetical progression, and their difference an aliquot part of 2π, their number n. We can always make the first member 0, and thus the series becomes

$$0,\ z,\ 2z,\ \&c.\ (n-1)\,z, \text{ where } z = \frac{2\pi}{n},$$

In this case the following are the n equations :—

$$\left.\begin{aligned}
\alpha &= p + p_1 + p_2 + \&c.\\
\alpha_1 &= p + p_1 \cos z + q_1 \sin z + p_2 \cos 2z + q_2 \sin 2z + \&c.\\
\alpha_2 &= p + p_1 \cos 2z + q_1 \sin 2z + p_2 \cos 4z + q_2 \sin 4z + \&c.\\
&\quad \&c. \qquad \&c. \qquad \&c.\\
\alpha_{n-1} &= p + p_1 \cos (n-1)\,z + q_1 \sin (n-1)\,z + p_2 \cos (n-1)\,2z + q_2 \sin (n-1)\,2z + \&c.
\end{aligned}\right\} \quad (2.)$$

and the values of p, p_1, p_2, &c. q_1, q_2, &c. should be so chosen that the sum of the squares of the differences from the given values of α, α_1, α_2, &c., viz.:

$$\Sigma\,(-\,\alpha_m + p + p_1 \cos mz + q_1 \sin mz + \&c.)^2$$

shall be a minimum when the sum for all the values of m from 0 to $n-1$, inclusive, is taken.

If we make the differential coefficients of this sum, in respect of each of the unknown quantities $=2P$, $2P_1$, $2Q_1$, $2P_2$, $2Q_2$, &c., we get the equations—

$$\begin{aligned}
P &= \Sigma\,(-\,\alpha_m + p + p_1 \cos mz + q_1 \sin mz + \&c.)\\
P_1 &= \Sigma \cos mz\ (-\,\alpha_m + p + p_1 \cos mz + q_1 \sin mz + \&c.)\\
Q_1 &= \Sigma \sin mz\ (-\,\alpha_m + p + p_1 \cos mz + q_1 \sin mz + \&c.)\\
P_2 &= \Sigma \cos 2mz\ (-\,\alpha_m + p + p_1 \cos mz + q_1 \sin mz + \&c.)
\end{aligned}$$

The most probable values of p, p_1, p_2, &c., q_1, q_2, &c. are those which follow from these equations on the hypothesis that P, P_1, Q_1, &c. are each $= 0$. The number of direct observations whose mean is as accurate as the determination of p (the weight of p), is the reciprocal of the coefficient of P in the expression of p; the weight of p_1 is the reciprocal of the coefficient of P_1 in the expression of p_1, &c. &c.

These equations have a very simple solution, for when $n\,A$ is a multiple of 2π the sums

$$\sin A + \sin 2A + \&c. \ldots + \sin (n-1)A, \text{ and } 1 + \cos A + \cos 2A + \&c. \ldots + \cos (n-1)\,A,$$

disappear and all the terms of the equations, except one, can be reduced to sums of that nature, so that only this one term remains for each equation. This is for the first $\Sigma\, p = n\, p$, for the second $\Sigma\, p_1 \cos^2 mz = \frac{n}{2} p_1$, for the third $\Sigma\, q_1 \sin^2 mz = \frac{n}{2} q_1$, and similarly for all the succeeding ones. We have then

$$\begin{aligned} P &= -\Sigma\alpha_m + n\,p \\ P_1 &= -\Sigma\alpha_m \cos mz + \frac{n}{2} p_1 \\ Q_1 &= -\Sigma\alpha_m \sin mz + \frac{n}{2} q_1 \\ &\&c. \qquad \&c. \qquad \&c. \end{aligned}$$

or the most probable values of the unknown quantities,

$$\left.\begin{aligned} p &= \frac{1}{n}(\alpha + \alpha_1 + \alpha_2 + \ldots\ldots\ldots + \alpha_{n-1}) \\ p_1 &= \frac{2}{n}(\alpha + \alpha_1 \cos z + \alpha_2 \cos 2z + \ldots + \alpha_{n-1} \cos (n-1)\,z) \\ q_1 &= \frac{2}{n}(\qquad \alpha_1 \sin z + \alpha_2 \sin 2z + \ldots + \alpha_{n-1} \sin (n-1)\,z) \\ p_2 &= \frac{2}{n}(\alpha + \alpha_1 \cos 2z + \alpha_2 \cos 4z + \ldots + \alpha_{n-1} \cos (n-1)\,2z) \\ q_2 &= \frac{2}{n}(\qquad \alpha_1 \sin 2z + \alpha_2 \sin 4z + \ldots + \alpha_{n-1} \sin (n-1)\,2z) \\ &\qquad\qquad \&c. \qquad \&c. \qquad \&c. \end{aligned}\right\} \quad (3.)$$

The weight of $p = n$, that of the other coefficients $= \frac{n}{2}$.

If the form of expression (1.) be preferred, u_1 and U_1 are obtained from the values found for p_1 and q_1; u_2 and U_2 from p_2 and q_2, and so forth.

III.

This simple determination of the unknown quantities p, p_1, p_2, &c., q_1, q_2, &c. &c. has the advantage of being universally applicable, whether their number be less, equal to, or even greater than the number of the observations. In the first case the problem is more than determined, and therefore will best be solved by applying the method of least squares; in the second it is determined; in the third it is undetermined; on which account the unknown quantities cannot be discovered individually, but only in connexion with each other.

The equations which are to be solved

$$0 = -\alpha_m + p + p_1 \cos mz + q_1 \sin mz + \&c.$$

consist, if we regard them as proceeding without limit, of terms whose coefficients recur periodically; the period begins anew when, in the series of angles whose cosines and sines are the coefficients, we come to $n\,m\,z = m\;360°$. The term at which this occurs unites itself with p, the succeeding ones with p_1, q_1, p_2, q_2, . . respectively; by this means that which has been expressed by these letters, in the case of the series proceeding without limit, will be

$$\begin{aligned}&p + p_n + p_{2n} + \&c.\\ &p_1 + p_{n+1} + p_{2n+1} + \&c.\\ &q_1 + q_{n+1} + q_{2n+1} + \&c.\\ &p_2 + p_{n+2} + p_{2n+2} + \&c.\end{aligned}$$

If we write for these, A, A_1, B_1, A_2, B_2, &c. the following equations are solved—

$$\begin{aligned}0 &= -\alpha + A + A_1 + \ldots\ldots\ldots\ldots\ldots\ldots + A_{n-1}\\ 0 &= -\ldots\ldots\alpha_1 + A + A_1 \cos z + B_1 \sin z + \ldots + B_{n-1} \sin (n-1)z\\ &\qquad\qquad \&c. \qquad \&c. \qquad \&c.\\ 0 &= -\alpha_{n-1} + A + A_1 \cos (n-1)z + B_1 \sin (n-1)z + \ldots + B_{n-1} \sin (n-1)^2 z,\end{aligned}$$

but as in general

$$\begin{aligned}\cos a &= \cos (2\pi - a) = \cos (4\pi - a) = \&c.\\ \sin a &= -\sin (2\pi - a) = -\sin (4\pi - a) = \&c.\end{aligned}$$

A and A_{n-1}, A_2 and A_{n-2}, &c. have equal coefficients, and B_1 and B_{n-1}, B_2 and B_{n-2}, &c. have coefficients of equal magnitude and opposite signs, so that these equations may also be written

$$0 = -\alpha_m + A + (A_1 + A_{n-1}) \cos mz + (B_1 - B_{n-1}) \sin mz + \&c.$$

If n be *even*, in the series of angles 0, z, $2z$, the angle $\frac{n}{2}z$ occurs, which $= \pi$. The term depending on this remains separate, while those beyond it unite themselves with those which precede them, so that in this case we obtain the equations

$$\begin{aligned}0 = -\alpha_m &+ A + (A_1 + A_{n-1}) \cos mz + (B_1 - B_{n-1}) \sin mz + \&c.\\ &+ \left(A_{\frac{n}{2}-1} + A_{\frac{n}{2}+1}\right) \cos \left(\frac{n}{2}-1\right) mz + \left(B_{\frac{n}{2}-1} - B_{\frac{n}{2}+1}\right) \sin \left(\frac{n}{2}-1\right) mz\\ &+ A_{\frac{n}{2}} \cos m\pi.\end{aligned}$$

But if n be *odd*, $\frac{n}{2}z$ is not among the angles 0, z, $2z$, &c., and all the terms unite themselves in pairs, so that the form of the equations is

$$\begin{aligned}0 = -\alpha_m &+ A + (A_1 + A_{n-1}) \cos mz + (B_1 - B_{n-1}) \sin mz + \&c.\\ &+ \left(A_{\frac{n-1}{2}} + A_{\frac{n+1}{2}}\right) \cos \frac{n-1}{2} mz + \left(B_{\frac{n-1}{2}} - B_{\frac{n+1}{2}}\right) \sin \frac{n-1}{2} mz.\end{aligned}$$

In both cases the number of unknown quantities is the same as that of the equations $= n$. Their complete expressions are, as we have said above,

$$\begin{aligned}&p + p_n + p_{2n} + \&c.\\ &p_1 + p_{n-1} + p_{n+1} + p_{2n-1} +\\ &q_1 - q_{n-1} + q_{n+1} - q_{2n-1} +\\ &p_2 + p_{n-2} + p_{n+2} + p_{2n-2} +\\ &q_2 - q_{n-2} + q_{n+2} - q_{2n-2} + \&c.\end{aligned}$$

to which in the first case, when n is *even*,

$$p_{\frac{n}{2}} + p_{\frac{3n}{2}} + p_{\frac{5n}{2}} + \ldots \text{ is added.}$$

From 5 given values of y, e.g., those belonging to the angles

$$0°, \quad 72°, \quad 144°, \quad 216°, \quad 288°,$$

we find, instead of p, p_1, q_1, p_2, q_2, the following

$$\begin{aligned}
&p + p_5 + p_{10} + \&c. \\
&p_1 + p_4 + p_6 + p_9 + \&c. \\
&q_1 - q_4 + q_6 - q_9 + \&c. \\
&p_2 + p_3 + p_7 + p_8 + \&c. \\
&q_2 - q_3 + q_7 - q_8 + \&c.
\end{aligned}$$

From 6 given values, belonging to the angles 0°, 60°, 120°, 180°, 240°, 300°, the following

$$\begin{aligned}
&p + p_6 + p_{12} \\
&p_1 + p_5 + p_7 + p_{11} + \&c. \\
&q_1 - q_5 + q_7 - q_{11} + \&c. \\
&p_2 + p_4 + p_8 + p_{10} + \&c. \\
&q_2 - q_4 + q_8 - q_{10} + \&c. \\
&p_3 + p_9 + p_{15} + \&c.
\end{aligned}$$

and so in all cases. This shows us how the unknown quantities coalesce when their number is greater than that of the given values of y. If, *e.g.*, for $n = 6$, the expression went as far as to the fourth angles, inclusive, the last example shows us that we get p, p_1, q_1, q_3, certainly separated, but $p_2 + p_4$, $q_2 - q_4$ are combined with each other.

IV.

The development of the expression which represents the given values of y will in general only be interesting when it converges so rapidly that only a few of the first terms have appreciable values. In that case, when we do not know on other grounds how far the expression goes, we shall generally close the investigation of the unknown quantities when the sum of the squares of the remaining errors is so small that we may fairly attribute them to errors of observation or other interruptions of regularity. In order to facilitate forming a judgment on this, I shall give the expression for the sum of the squares of the errors.

It is well known that if the equations are written in the following form:

$$\begin{aligned}
\epsilon &= -\alpha + a\,x + b\,y + c\,z + \&c. \\
\epsilon' &= -\alpha' + a'\,x + b'\,y + c'\,z + \&c. \\
\epsilon'' &= -\alpha'' + a''\,x + b''\,y + c''\,z + \&c. \\
&\quad \&c. \qquad \&c. \qquad \&c.
\end{aligned}$$

and $x, y, z, \ldots$ indicate the most probable values of the unknown quantities, then the sum of the squares of the errors

$$\epsilon^2 + \epsilon'^2 + \epsilon''^2 + \&c. = [\alpha\alpha]^* - [a\alpha]\,x - [b\alpha]\,y - [c\alpha]\,z - \&c.$$

where $[\alpha\alpha]$, $[a\alpha]$, $[b\alpha]$, $[c\alpha]$, are the known symbols used by Gauss for

$$\begin{aligned}
&\alpha\alpha + \alpha'\alpha' + \alpha''\alpha'' + \ldots\ldots \\
&a\alpha + a'\alpha' + a''\alpha'' + \ldots\ldots \\
&b\alpha + b'\alpha' + b''\alpha'' + \ldots\ldots \\
&\quad \&c. \qquad \&c. \qquad \&c.
\end{aligned}$$

but in our case $[a\alpha] = np$, $[b\alpha] = \frac{n}{2}p_1$, $[c\alpha] = \frac{n}{2}q_1$, $[d\alpha] = \frac{n}{2}p_2$, &c., whereby the sum of the squares of the errors

$$= [\alpha\alpha] - np^2 - \frac{n}{2}\,p_1^2 - \frac{n}{2}\,q_1^2 - \frac{n}{2}\,p_2^2 + \&c. \qquad (4.)$$

---

* NOTE.—The symbol [ ] indicates summation.

If therefore we subtract n times the square of p from $[\alpha\ \alpha]$ the remainder will contain terms depending upon p_1, q_1 &c.; if we further subtract $\frac{n}{2}p_1^2$, the remainder will contain terms depending upon q_1, p_2, q_2, &c. In this way the sum of the squares of the errors which remain after the introduction of each new term can be easily found, and it is unnecessary to carry the calculation beyond the point where we arrive at a satisfactorily small amount for this error. If the calculation be completed, it is evident that the error will vanish entirely, so that then you can only detect the probable errors of observation from the residual differences, when you otherwise know where the expression comes to an end.

V.

It sometimes happens that the values of y are not known, for all the angles 0, z, $2z$, . . $\overline{n-1}z$, or that among the quantities α, α_1, α_2, . . α_{n-1}, one or more than one are wanting. In this case also the solution which has been given can be applied when it is properly modified.

If the values of y for the angles hz, iz, are unknown, α_h, α_i, cannot be brought among the sums $[\alpha]$, $[\alpha \cos mz]$, $[\alpha \sin mz]$, but they can be added as unknown quantities to the sums obtained from all the known values of y, so that p, p_1, q_1, . . shall contain these unknown quantities in their expressions. We have then

$$p = \frac{\alpha}{n} + \frac{\alpha_h}{n} + \frac{\alpha^i}{n} + \&c.$$

$$p_1 = \frac{2}{n}[\alpha \cos z] + \frac{2}{n}\ \alpha_h \cos\ hz + \frac{2}{n}\alpha_i \cos iz + \&c.$$

$$q_1 = \frac{2}{n}[\alpha\ \sin z] + \frac{2}{n}\ \alpha_h \sin\ hz + \frac{2}{n}\ \alpha_i \sin iz + \&c.$$

$$p_2 = \frac{2}{n}[\alpha \cos 2z] + \frac{2}{n}\ \alpha_h \cos\ 2hz + \frac{2}{n}\alpha_i \cos 2iz + \&c.$$

If we introduce these values of p, p_1, q_1, . . into the expressions for α_h, α_i, i.e. in

$$\alpha_h = p + p_1 \cos hz + q_1 \sin hz + \&c.$$
$$\alpha_i = p + p_1 \cos iz + q_1 \sin iz + \&c.,$$

we obtain as many equations as unknown quantities α_h, α_i, so that these can be obtained and inserted in the expressions of p, p_1, q_1, . . which are affected by them. It is easy to see that these equations have the same form as those which can be solved by the method of least squares.

If the values of y be complete, we see, as has been shown before, that the determination of a term of the expression remains the same whether this latter extends beyond that term or closes therewith. This advantage is lost if any values of y are missing; we get other values of the unknown quantities according to whether the expression ends at an earlier or later term. The case is the same with their weights. This shows that an uninterrupted series of the known values of y not only secures the easiest calculation, but is necessary to neutralize the influence of the fact that the termination of the expression is unknown. If values of y are wanting we obtain the weights of p, p_1, q_1, in the same way as their values, for we substitute

$$p = \frac{1}{n}P + \frac{1}{n}\alpha_h + \frac{1}{n}\alpha_i + \&c.$$

$$p_1 = \frac{2}{n}P_1 + \frac{2}{n}\alpha_h \cos hz + \frac{2}{n}\alpha_i \cos iz + \&c.$$

$$q_1 = \frac{2}{n}Q_1 + \frac{2}{n}\alpha_h \sin hz + \frac{2}{n}\alpha_i \sin iz + \&c.,$$

in the expressions

$$\alpha_h = p + p_1 \cos hz + q_1 \sin hz + \&c.$$
$$\alpha_i = p + p_1 \cos iz + q_1 \sin iz + \&c.$$

and obtain as many equations as there are unknown quantities α_h, α_i, &c. These give α_h, α_i, expressed in P, P_1, Q_1, . . . and when you insert these values in

$$\frac{1}{n}P+\frac{1}{n}\alpha_h+\frac{1}{n}\alpha_i+\&c.$$

$$\frac{2}{n}P_1+\frac{2}{n}\alpha_h\cos hz+\frac{2}{n}\alpha_i\cos iz+\&c.$$

$$\frac{2}{n}Q_1+\frac{2}{n}\alpha_h\sin hz+\frac{2}{n}\alpha_i\sin iz+\&c.,$$

$$\&c. \qquad \&c. \qquad \&c.$$

the reciprocal of the co-efficients of P in the first, of P_1 in the second, and of Q_1 in the third is the weight of p, p_1, q_1, &c. respectively. We see at once that this mode of determining the unknown quantities and their weights is easier than the solution of the equations which we obtain if we do not bring α_h, α_i, into the calculation, even if the number of these last be less than that of p, p_1, q_1, &c. which are to be determined.

VI.

In order to explain this method by an example, I shall look for the formulæ of a yearly period which is derivable from the temperature for every fifth day in the year at Königsberg, derived from the 24 years observations (1799–1822 inclusive) made by the late Pastor Sommer. These data are found in No. 26, Astron. Nachr. There are 73 of them for the 3rd, 8th, 13th, . . . 363rd day of the year. Inasmuch as between the 363rd day of one year and the 3rd of the next there are not 5 days exactly, but on an average 5·2422 days, we have added this difference to the times of observation, and taken each interval at 5·00332 days.

We have therefore $z=\frac{360^\circ}{73}=4^\circ\ 55'\ 53''\cdot 425$,

and therewith we find

$[\alpha] = +\ 368^\circ\cdot 32$ Reaumur

$[\alpha\cos z] = -\ 298\cdot 91$

$[\alpha\sin z] = -\ 89\cdot 51$

$[\alpha\cos 2z] = +\ 2\cdot 86$

$[\alpha\sin 2z] = +\ 2\cdot 65$

$[\alpha\cos 3z] = +\ 1\cdot 77$

$[\alpha\sin 3z] = -\ 3\cdot 90$

$[\alpha\cos 4z] = -\ 16\cdot 51$

$[\alpha\sin 4z] = +\ 11\cdot 68$

If we divide the first number by 73, and the following ones by 36·5, we have—

$p = 5\cdot 0454$

$p_1 = -\ 8\cdot 1894$

$p_2 = +\ 0\cdot 0784$

$p_3 = +\ 0\cdot 0485$

$p_4 = -\ 0\cdot 4523$

$q_1 = -\ 2\cdot 4523$

$q_2 = +\ 0\cdot 0726$

$q_3 = -\ 0\cdot 1068$

$q_4 = +\ 0\cdot 3200$

The sum of the squares of the observed temperatures is 4547·78. The constant term (the mean temperature) reduces it (4.) by 1858·30, p_1 and q_1 by 2667·40, so that it is reduced by these three terms to 22·08. The further reduction by p_2 and q_2 is only 0·42, by p_3 and q_3 only 0·50; but p_4 and q_4 have a greater effect as they cause a reduction of 11·21. By the use of these terms the observations are represented so that the sum of the squares of the remaining differences is 9·95. If we wished to push the calculation further, we should certainly exhaust all the differences, but the process would be so slow that little would be gained by adding more terms. The causes which disturb the regular march of temperature are too great not to have a marked influence on the mean of 24 years, and even a longer series of observations would only give a reliable daily march of temperature if the observations of each day were so arranged that their result should give the mean of the day. Other observations must decide the point whether the greater influence of the fourfold angle which has been found depends on the nature of the phenomenon, or is only a consequence of the disturbance of its regularity. In order to be able to see in how far the formula agrees with the observations, I give a double comparison, I. with the first 3 terms of the formula, II. with those as far as q_4.

—	Obs.	Formula.		—	Obs.	Formula.	
		I.	II.			I.	II.
January 3	− 4·04	+0·90	+0·57	July 2	+12·73	+0·39	−0·10
" 8	− 4·12	+0·79	+0·58	" 7	+13·63	−0·30	−0·64
" 13	− 3·72	+0·28	+0·22	" 12	+13·64	−0·16	−0·30
" 18	− 2·45	−1·04	−0·94	" 17	+13·27	+0·30	+0·38
" 23	− 3·36	−0·13	+0·13	" 22	+14·04	−0·45	−0·15
" 28	− 2·61	−0·81	−0·41	" 27	+14·21	−0·66	−0·16
February 2	− 2·17	−1·12	−0·63	August 1	+14·12	−0·67	−0·02
" 7	− 3·09	0.00	+0·53	" 6	+14·01	−0.72	+0·02
" 12	− 3·21	+0·37	+0·88	" 11	+13·76	−0·73	+0·06
" 17	− 2·21	−0·31	+0·13	" 16	+13·52	−0·74	−0·04
" 22	− 1·74	−0·41	−0·12	" 21	+12·56	−0·12	+0·46
" 27	− 1·26	−0·47	−0·34	" 26	+12.42	−0·38	+0·02
March 4	− 0·72	−0·54	−0·58	" 31	+11·98	−0·39	−0·21
" 9	− 1·12	+0·38	+0·16	September 5	+10·62	+0·47	+0·42
" 14	− 0·11	−0·06	−0·43	" 10	+10·46	+0·09	−0·19
" 19	+ 0·05	+0·38	−0·10	" 15	+ 9·46	+0·51	+0·04
" 24	− 0·25	+1·31	+0·78	" 20	+ 8·82	+0·53	−0·08
" 29	+ 0·80	+0·93	+0·41	" 25	+ 8·48	+0·22	−0·46
April 3	+ 1·75	+0·67	+0·21	" 30	+ 7·28	+0·74	+0·06
" 8	+ 3·02	+0·11	−0·22	October 5	+ 6·89	+0·43	−0·18
" 13	+ 3·95	−0·06	−0·27	" 10	+ 5·75	+0·84	+0·36
" 18	+ 4·96	−0·37	−0·37	" 15	+ 5·50	+0·38	+0·06
" 23	+ 5·37	−0·05	+0·13	" 20	+ 5·47	−0·33	−0·45
" 28	+ 6·12	−0·07	+0·25	" 25	+ 4·55	−0·14	−0·07
May 3	+ 7·40	−0·62	−0·19	" 30	+ 3·34	+0·34	+0·58
" 8	+ 7·93	−0·44	+0·03	November 4	+ 3·28	−0·32	+0·05
" 13	+ 8·54	−0·35	+0·10	" 9	+ 2·90	−0·65	−0·20
" 18	+ 9·54	−0·68	−0·30	" 14	+ 1·48	+0·09	+0·55
" 23	+ 9·75	−0·24	0.00	" 19	+ 1·20	−0·29	+0·12
" 28	+10·07	+0·04	+0·12	" 24	+ 0·82	−0·54	−0·23
June 2	+10·33	+0·35	+0·25	" 29	+ 0·20	−0·51	−0·34
" 7	+11·50	−0·28	−0·57	December 4	− 0·84	−0·03	−0·01
" 12	+11·41	+0·29	−0·15	" 9	− 1·21	−0·16	−0·30
" 17	+11·02	+1·12	+0·57	" 14	− 1·79	−0·05	−0·32
" 22	+11·45	+1·07	+0·47	" 19	− 3·09	+0·74	+0·48
" 27	+12·05	+0·80	+0·22	" 24	− 2·34	−0·26	−0·67
				" 29	− 3·63	+0·73	+0·33

From the values of p_1, q_1, which are given above we get

$u_1 = 8^\circ{\cdot}5487 \qquad U_1 = 253^\circ\, 19'{\cdot}8$

$u_2 = 0\,{\cdot}1068 \qquad U_2 = 47 \quad 12{\cdot}0$

$u_3 = 0\,{\cdot}1173 \qquad U_3 = 155 \quad 34{\cdot}6$

$u_4 = 0\,{\cdot}5542 \qquad U_4 = 305 \quad 16{\cdot}7$

In addition $k = 365{\cdot}2422$ and $\frac{2\pi}{k} = 59'\, 8''{\cdot}33$ = the mean daily motion of the sun. If x is the time counted in days from the 3rd of January, the formula for the temperature in Reaumur's scale is—

$$\begin{aligned} y = &+ 5^\circ{\cdot}0454 + 8^\circ{\cdot}5487 \sin (253^\circ 19'{\cdot}8 + x\, 59'\, 8''{\cdot}33) + 0{\cdot}1068 \sin \;(47^\circ 12'{\cdot}0 + 2\,x\, 59'\, 8''{\cdot}33) \\ &+ 0{\cdot}1173 \;\sin (155^\circ{\cdot}34'{\cdot}6 + 3\,x\, 59'{\cdot}8''{\cdot}33) + 0{\cdot}5542 \sin (305^\circ{\cdot}16'{\cdot}7 + 4\,x\, 59'\, 8''{\cdot}33) \end{aligned}$$

If we wish to make this formula depend on the mean solar longitude $= m$ we have to make $x\, 59'\, 8''{\cdot}33 = m - m'$, where m' is the mean solar longitude for the 3rd day of the year, and in the mean of the years 1799 to 1822, $m' = 282^\circ\, 33'{\cdot}6$, we have then

$$\begin{aligned} m - m' &= \;m - 282^\circ\;\; 33'{\cdot}6 \\ 2\,(m - m') &= 2m - 205 \quad\;\; 7{\cdot}2 \\ 3\,(m - m') &= 3m - 127 \quad 40{\cdot}8 \\ 4\,(m - m') &= 4m - \;\;50 \quad 14{\cdot}4 \end{aligned}$$

and therefore the formula which has been made dependent on the mean solar longitude is

$$\begin{aligned} y = 5{\cdot}0454 &+ 8'{\cdot}5487 \sin (\;m - \;\;29^\circ\; 13'{\cdot}8) \\ &+ 0{\cdot}1068 \;\sin (2m - 157 \;\; 55\,{\cdot}2) \\ &+ 0{\cdot}1173 \;\sin (3m - 332 \quad 6\,{\cdot}2) \\ &+ 0{\cdot}5542 \;\sin (4m - 104 \;\; 57\,{\cdot}7) \end{aligned}$$

If we compare a mathematical theory of this phenomenon, based on physical principles, with the observations, formulæ of this character would be more convenient for the purpose than the observations themselves. Such formulæ give a complete knowledge of the regular temperature of a place, and serve to discover the irregularities arising from the disturbances. They are better than graphical representations, inasmuch as they are freer from the irregularities of the phenomenon.

VII.

In the example which has been given the development of y is based on *observations*, but I would remark that periodic functions of a variable quantity whose mathematical expression is given but is too complex to take the direct form $u + u_1 \sin\,(U_1 + x) + u_2 \sin\,(U_2 + 2\,x) +$ &c. may be developed in this way if we set out from calculated values of y.

I have published a short paper on the extension of the same method to the development of functions of two angles in the Berlin Abhandlungen for 1820–21. Of this nature is, *e.g.*, the fraction whose numerator $= 1$ and whose denominator is the distance of two heavenly bodies, from whose development, according to the cosines and sines of the mean longitude of both bodies, the development of their mutual disturbance is based. Here I shall only add how periodical phenomena which depend on two or more angles can be developed from observations of the same.

If we designate the two angles by $x\; x'$, then in the expression

$$y = p + p_1 \cos x + q_1 \sin x + p_2 \cos 2x + q_2 \sin 2x + \text{\&c.}$$

the p, p_1, q_1, &c. which occur are not constant but depend on x', and as they are periodic functions of x', each of them has an expression of the form

$$a + a_1 \cos x' + b_1 \sin x' + a_2 \cos 2x' + b_2 \sin 2x' + \text{\&c.}$$

It is therefore necessary to deduce this development of p, p_1, q_1, from the observations.

If the available series of observations gives the values of y not only for n values of x, $(0, z, 2z, \ldots\ldots (n-1)\,z)$, which are in arithmetical progression, and fill up the period, but also for the combination of each of these values of x with n' values of x', $(0, z', 2z', \ldots\ldots (n'-1)\,z')$, fulfilling the same condition, the development has no difficulties. We determine in the first instance the development of y according to the period of x, using only the observations in which $x' = 0$, then by those observations only in which $x' = z'$, then by those belonging to $x' = 2z'$, &c. &c., until we reach those belonging to $x' = (n' - 1) z'$. We thus obtain n' developments of y and as many of each of the quantities p, p_1, q_1, which are in general different from each other. If we designate these n' values of one of them by α, α_1, α_2, α_{n-1}, we have thereby the equations

$$\begin{aligned}
\alpha &= a + a_1 + a_2 + \&c. \\
\alpha_1 &= a + a_1 \cos z' + b_1 \sin z' + a_2 \cos 2z' + b_2 \sin 2z' + \&c. \\
\alpha_2 &= a + a_1 \cos 2z' + b_1 \sin 2z' + a_2 \cos 4z' + b_2 \sin 4z' + \&c. \\
&\quad \&c. \qquad \&c. \\
\alpha_{n-1} &= a + a_1 \cos (n' - 1) z' + b_1 \sin (n' - 1) z' + a_2 \cos (n' - 1) 2z' + b_2 \sin (n' - 1) 2z' + \&c.
\end{aligned}$$

from which we may obtain by the same method a, a_1, b_1, a_2. It would be an instance of this if Sommer's observations of the temperature in Königsberg for every fifth day contained not one datum but several, *e.g.* for 0, 4, 8, 12, 16, 20 hours. We should then determine for each of these hours a formula like that given in article (VI.), and represent by the daily period the coefficients of these six formulæ. We might also proceed conversely and begin with the daily period, ending with the annual. It follows that both lead to the same result, for we can obtain in both ways the complete representation of the observations. The daily oscillation of the barometer is another case of the same nature, as it probably is not the same at various times of the year, and so follows the daily as well as the yearly period.

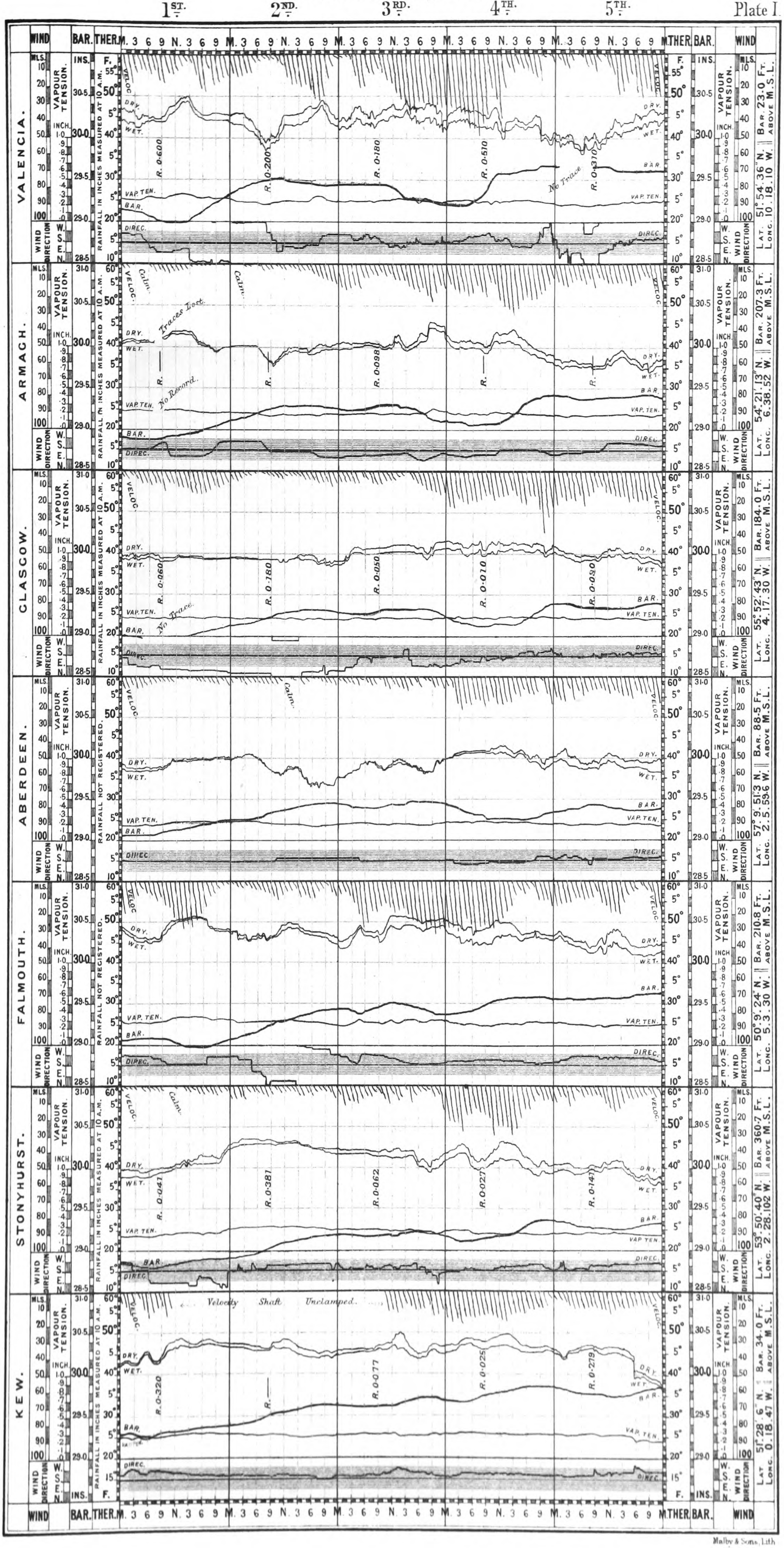
If the series of observations are not arranged as we have supposed, or if according to the nature of the phenomenon they cannot be so arranged, the development of the corresponding formula is less simple. If they be regular with reference to the period of x', i.e. made always for $x' = 0, z', 2z', \ldots (n' - 1) z'$, but irregular with reference to the period of x, it is always of importance to combine those made at each value of x' by a formula of the period of x, and then with the n' formulæ so obtained to proceed as has been given above. If the series of observations be very long, and if there be many values of x for each determined value of x', we shall be able to combine these with means which progress regularly, and thus to facilitate the calculation.

If we only wish to determine the terms which depend on x and x' singly, and not those in which both angles occur together, we obtain the development more easily by continual approximation. We shall then first neglect entirely the period which has the least influence, and seek a formula which depends on the other alone; then we subtract the values of y obtained from it from those observed, consider the remainder as dependant on the first period alone, and thereby obtain a second formula. If we bring in the result of this formula we obtain the first formula more easily, &c., &c. It is easy to see that we determine as many terms, following various periods, as the observations admit of. In reality this is the process which astronomers have used to deduce the coefficients of the lunar theory from the observations. The object of this paper is to show the advantage which the *regular* arrangement of the known values of y ensures in the determination of the development.

(Signed) BESSEL.

JANUARY,_1870.

Plate I.



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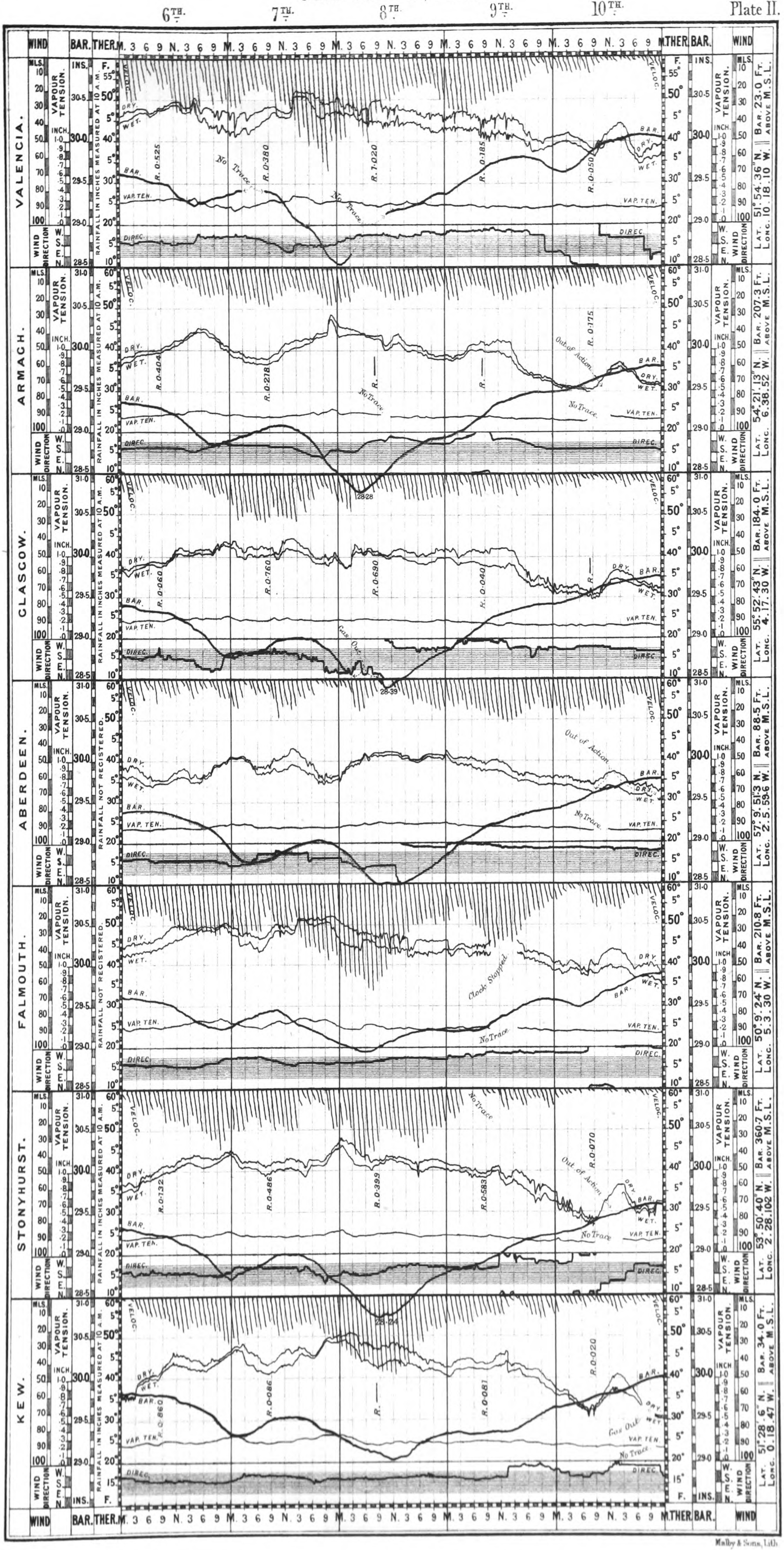
JANUARY, – 1870.

Plate II.



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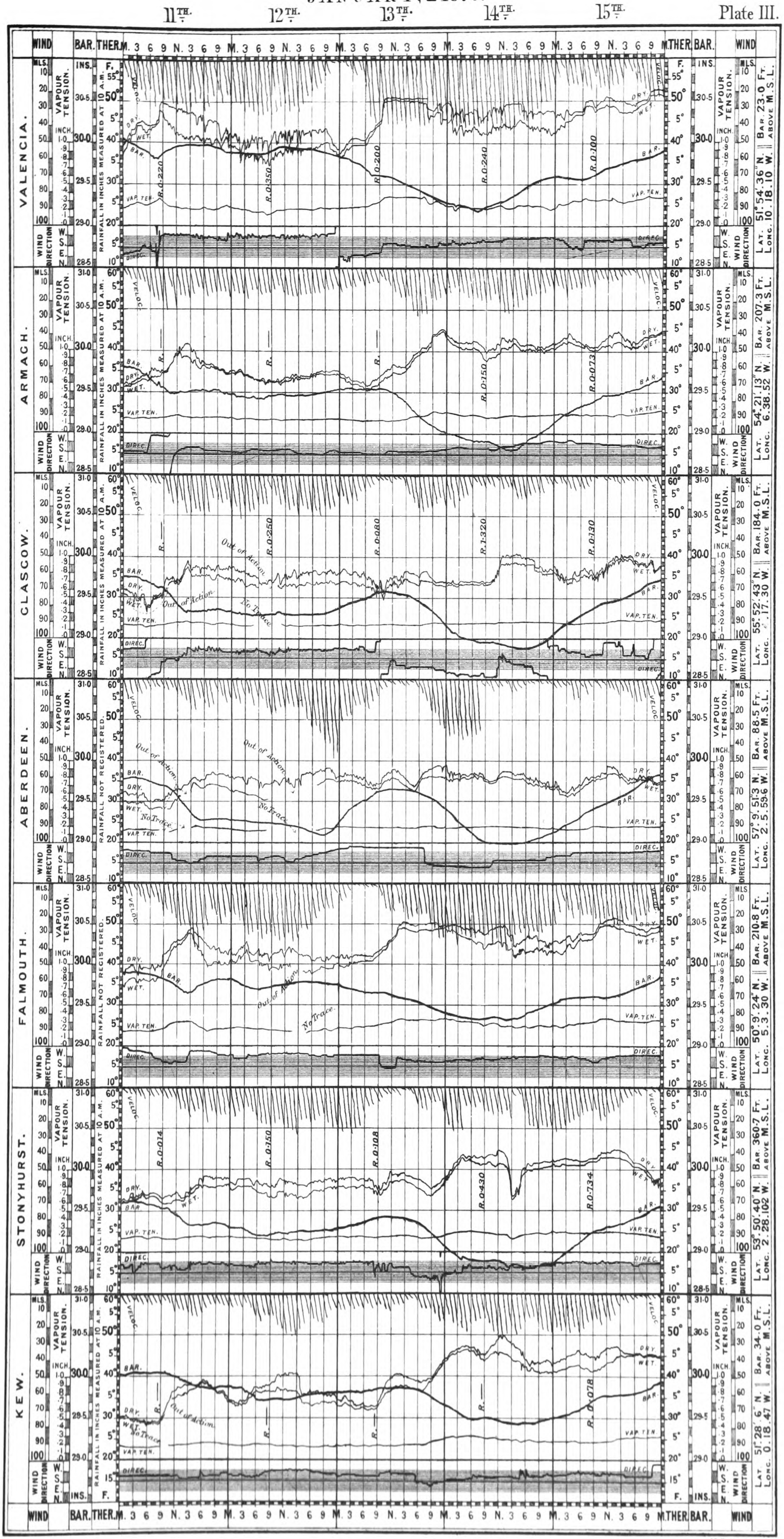
JANUARY, _1870.

Plate III.



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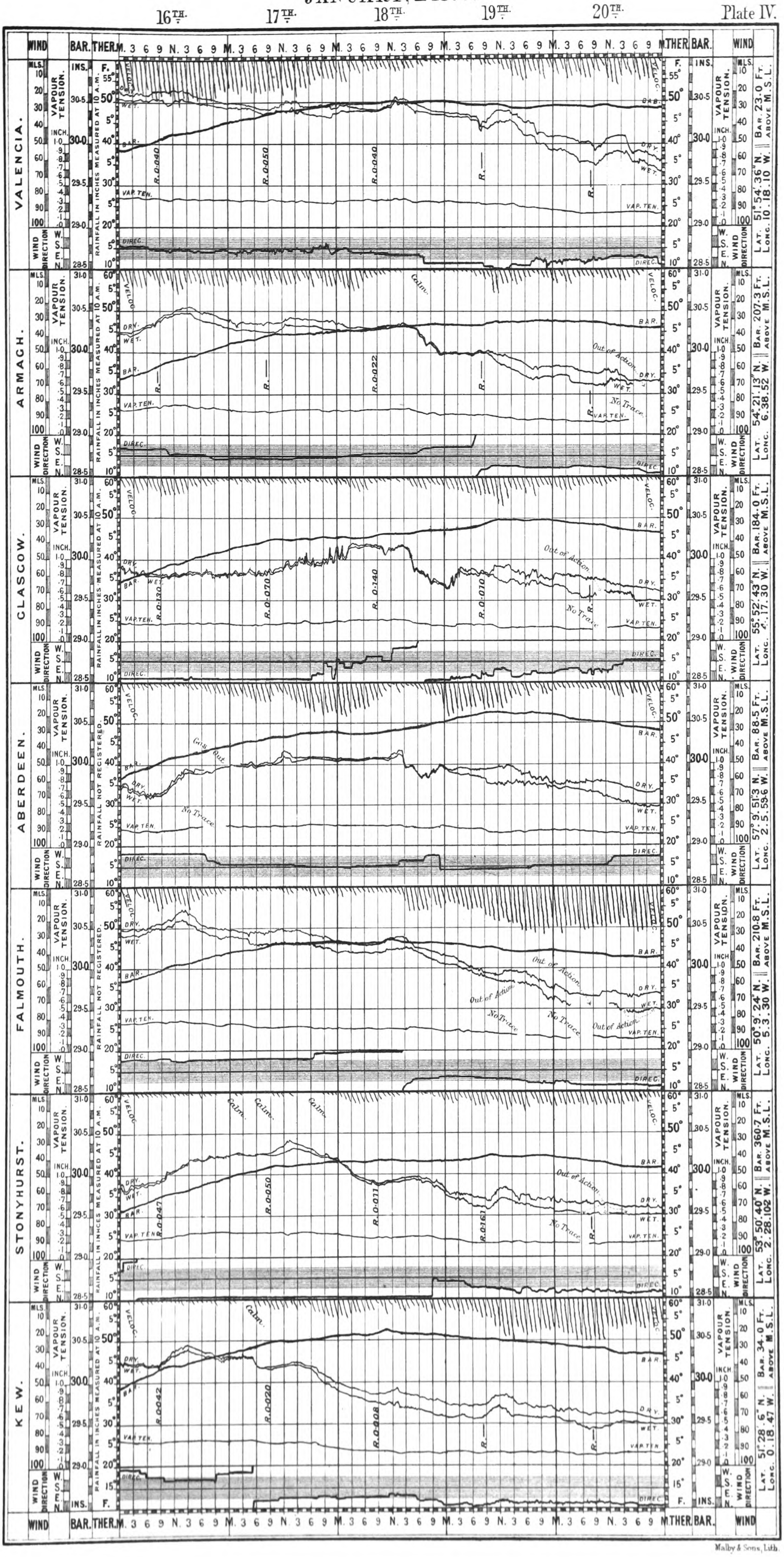

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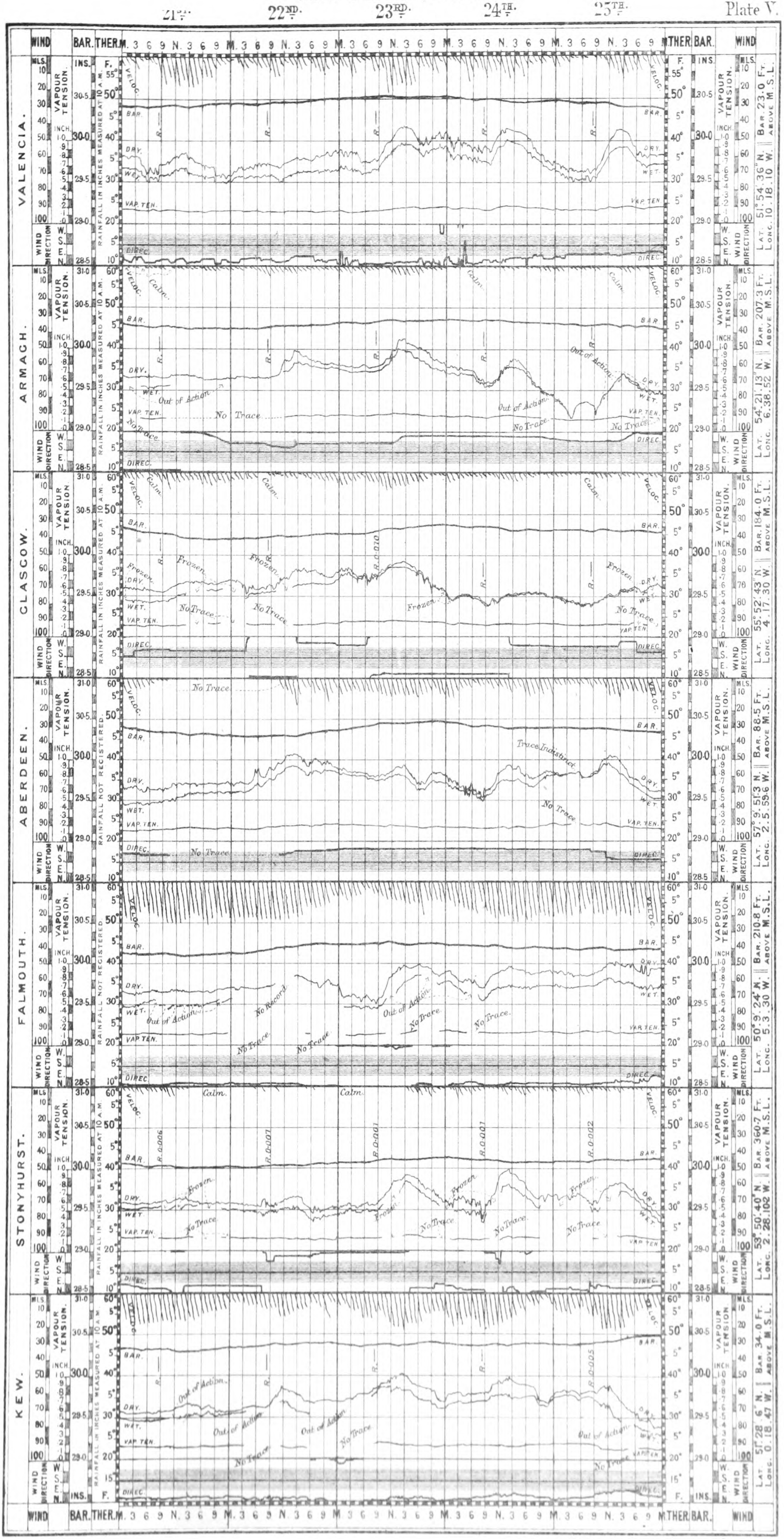
JANUARY, 1870.

Plate V.



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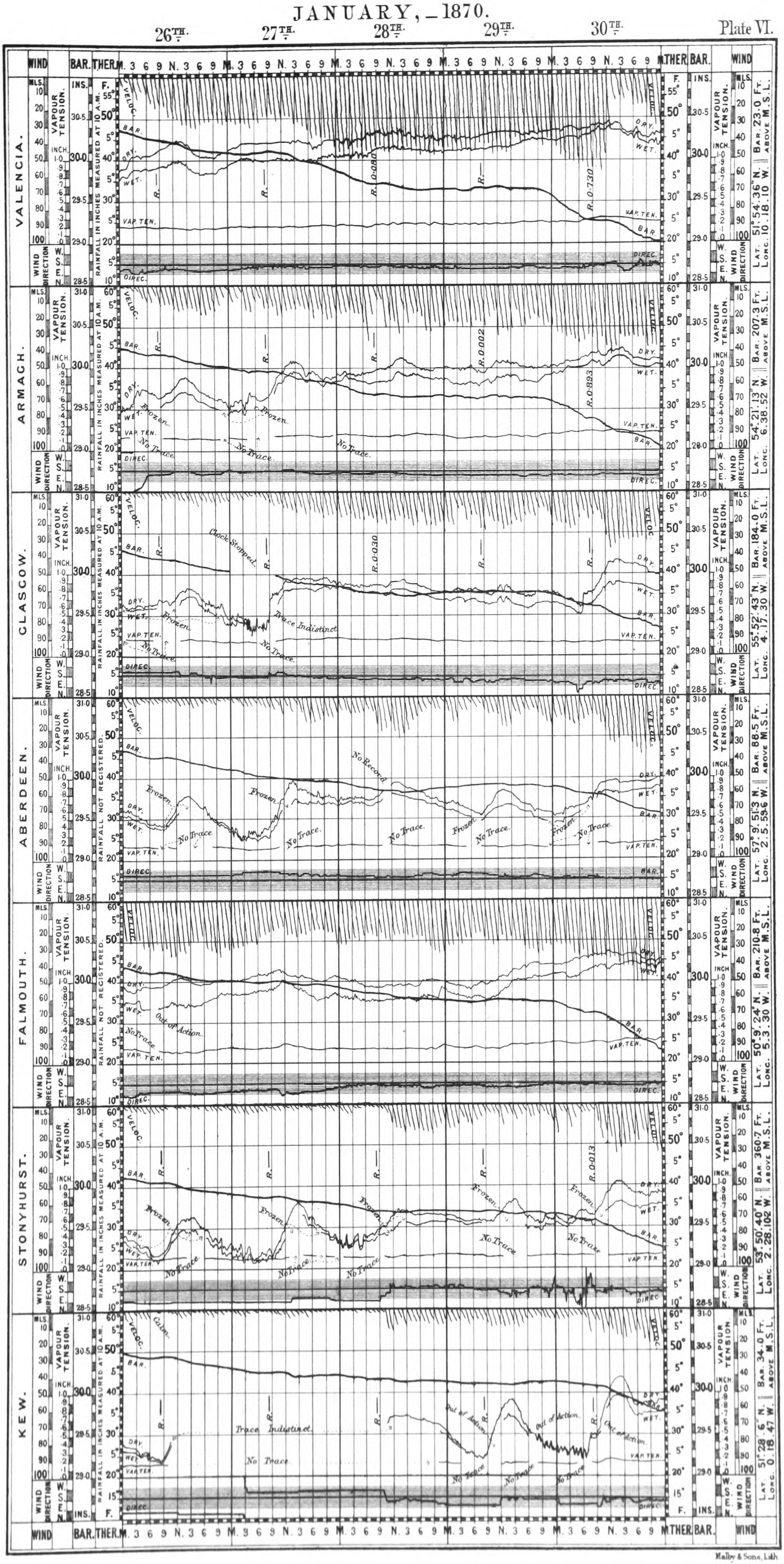
JANUARY, _ 1870.

Plate VI.



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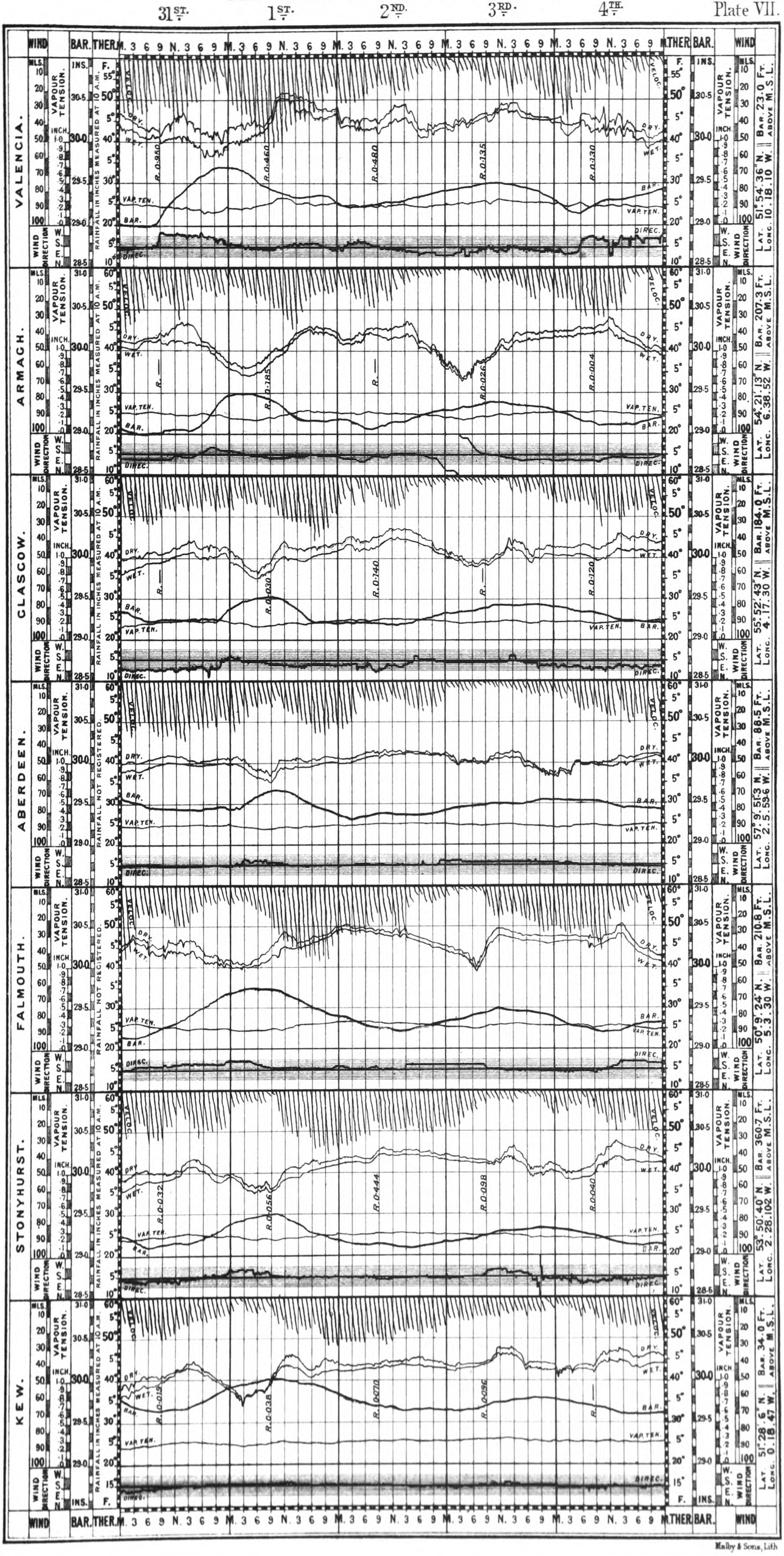
JANUARY & FEBRUARY, _1870.

Plate VII.



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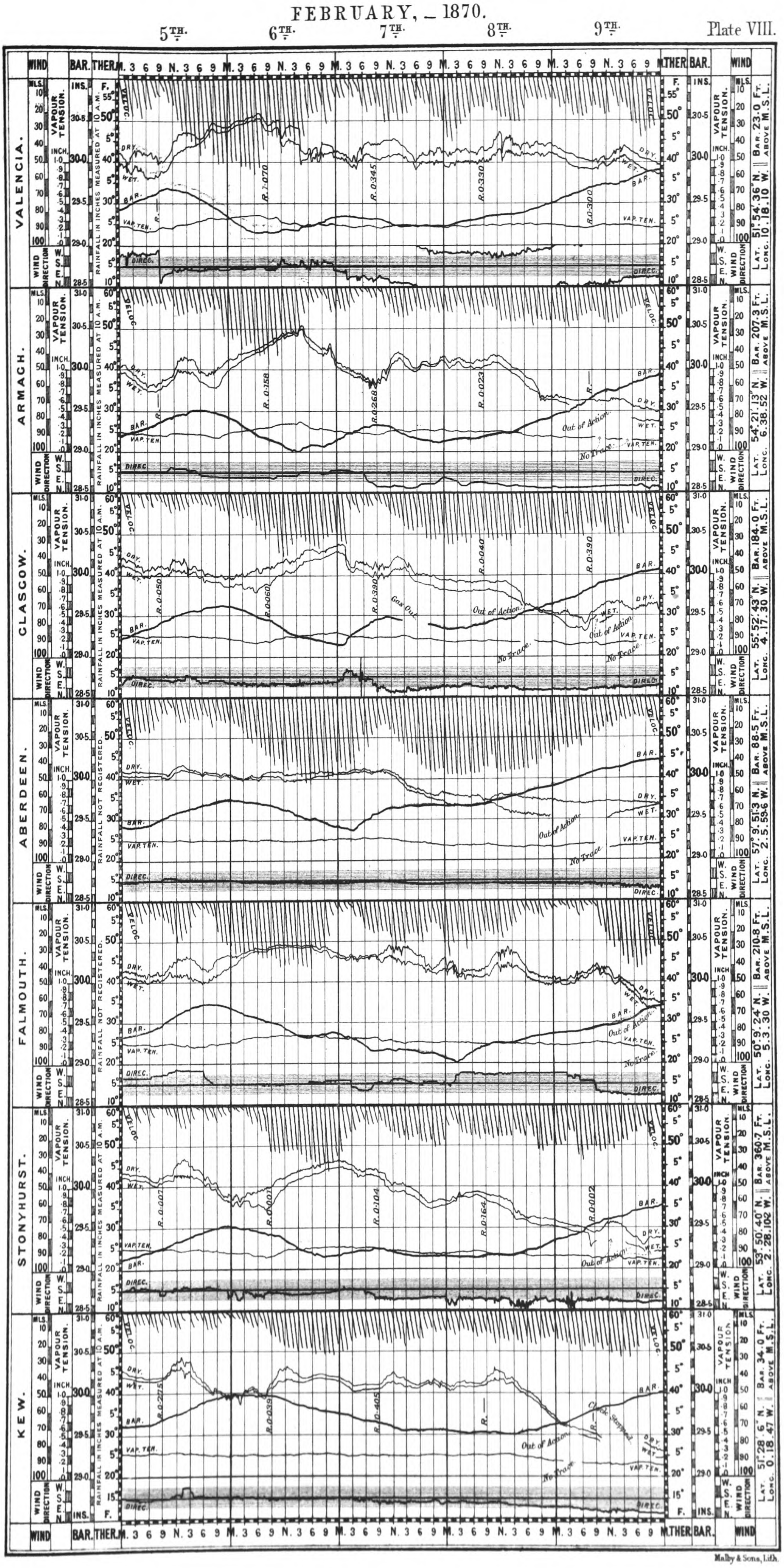
FEBRUARY, _ 1870.

Plate VIII.



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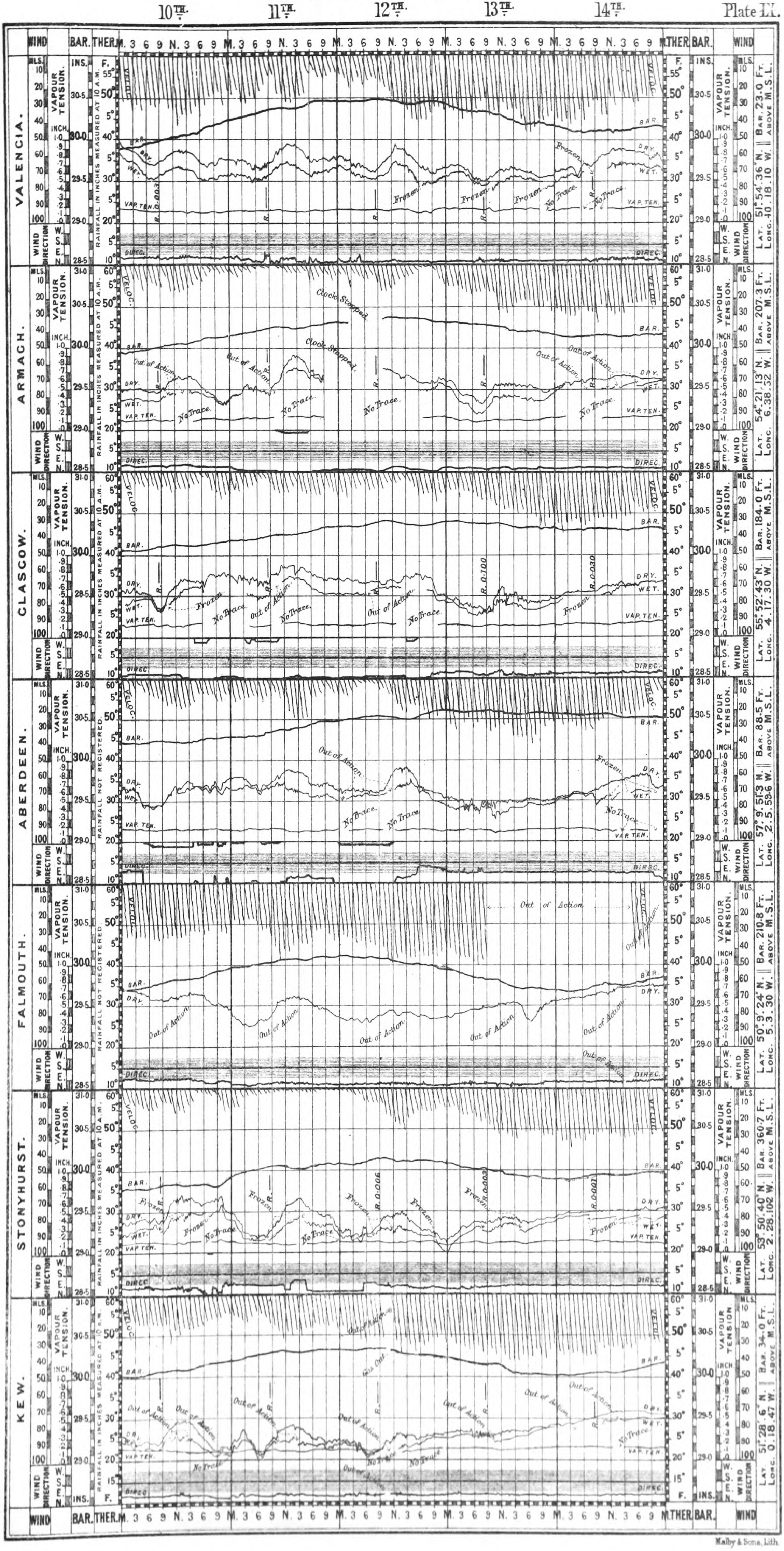
FEBRUARY, 1870.

Plate IX.



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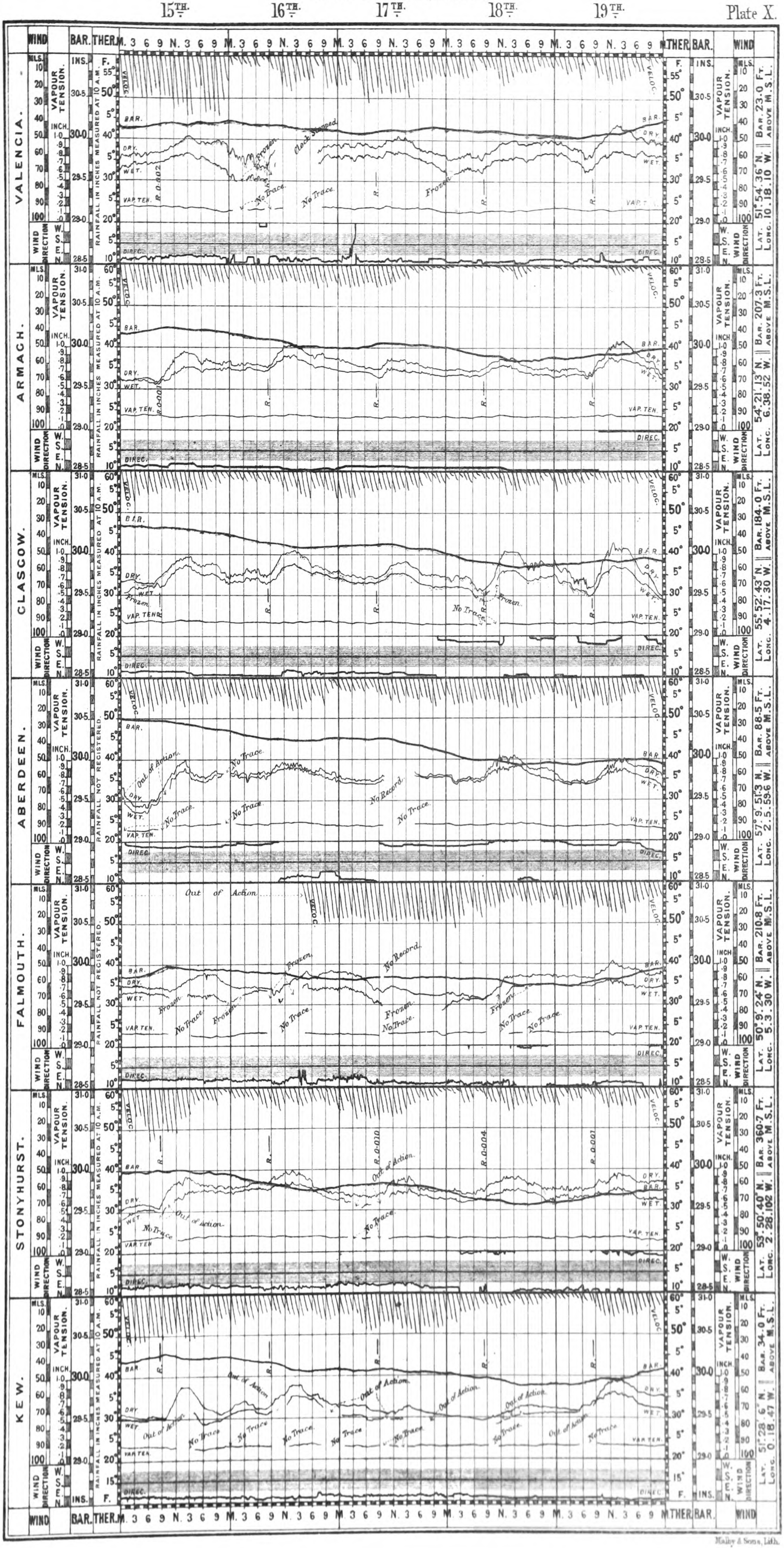
FEBRUARY, _1870.

Plate X.



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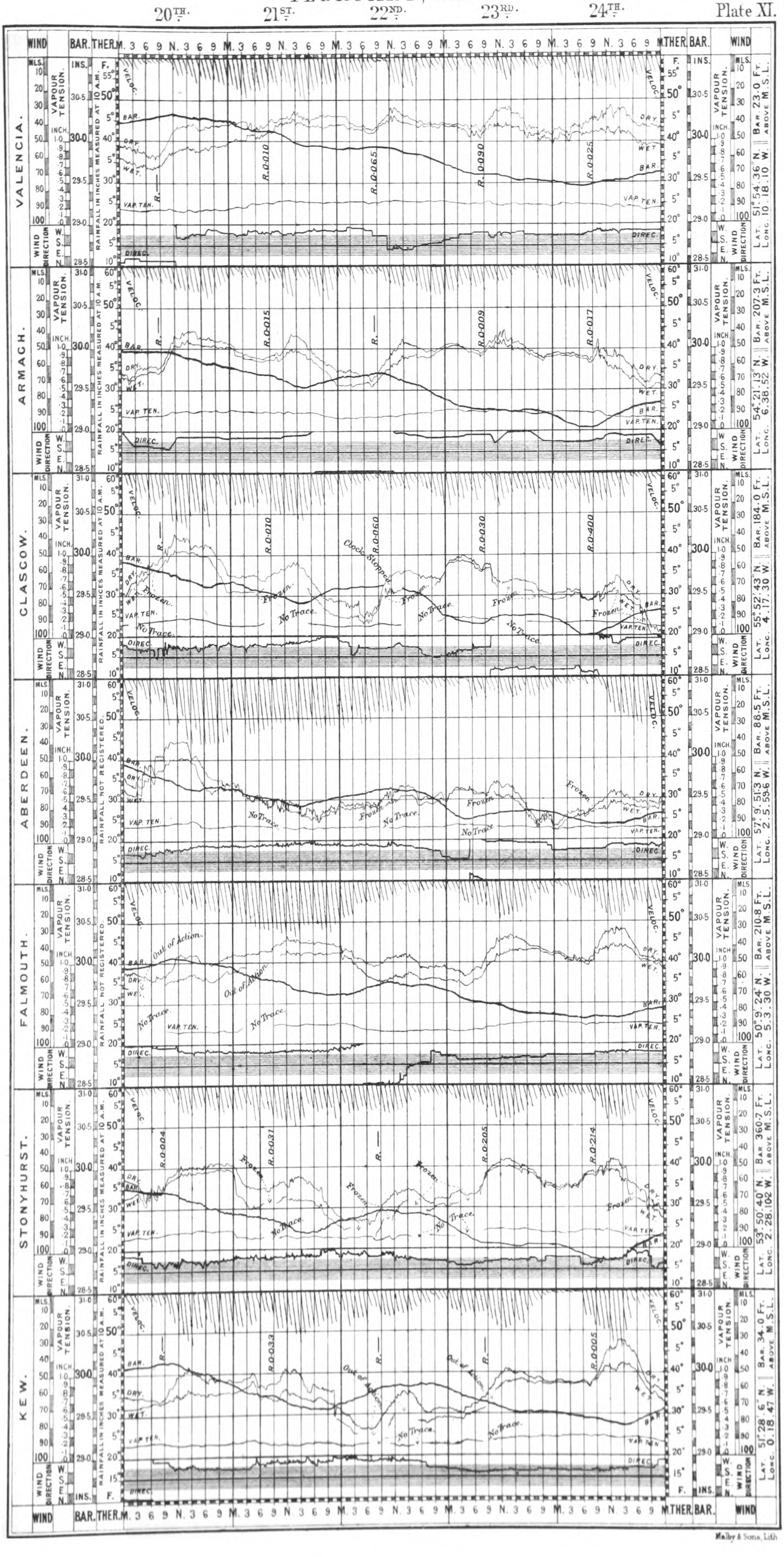
FEBRUARY, 1870.

Plate XI.



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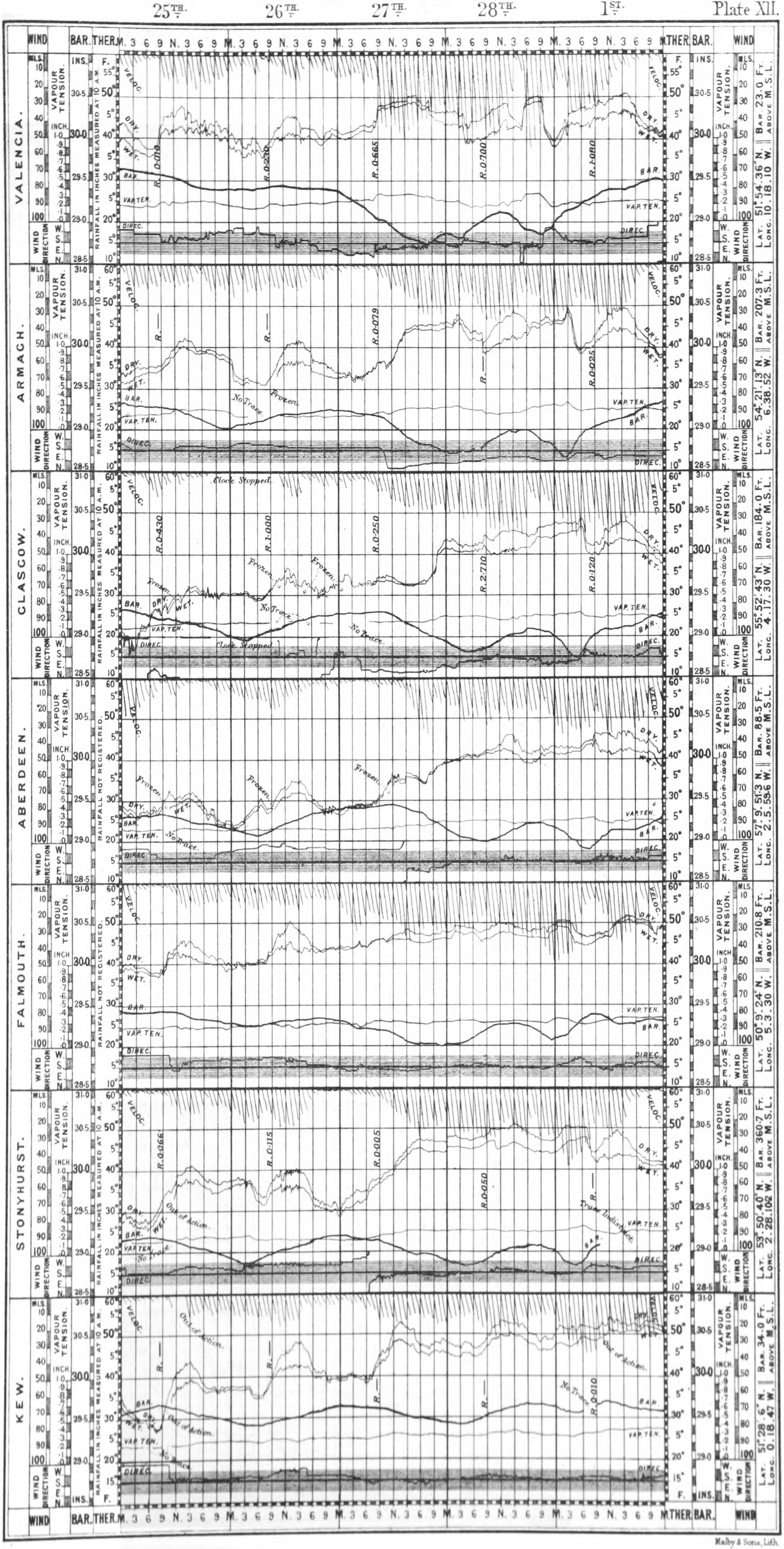
FEBRUARY & MARCH, 1870.



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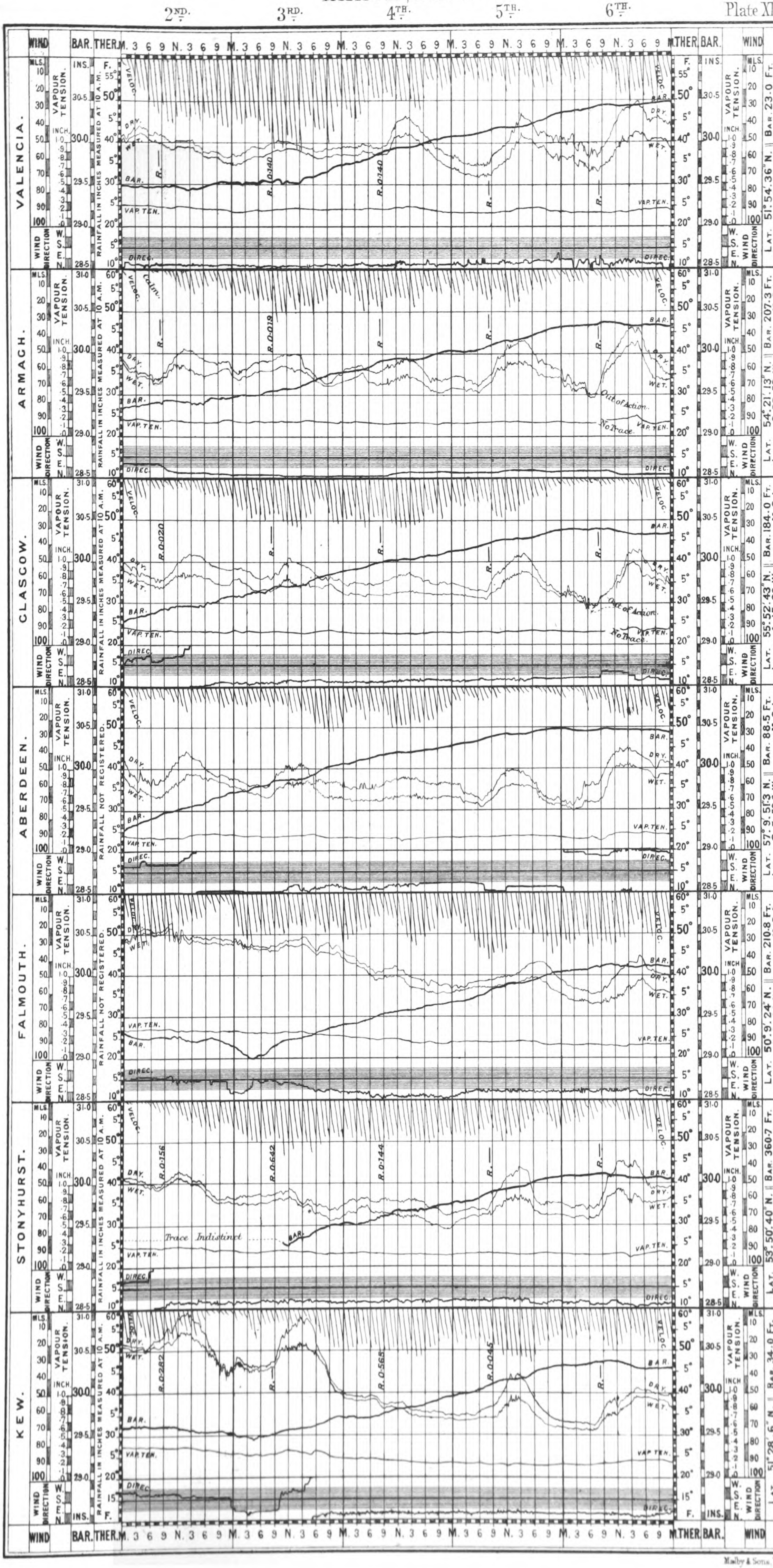
MARCH, _1870.



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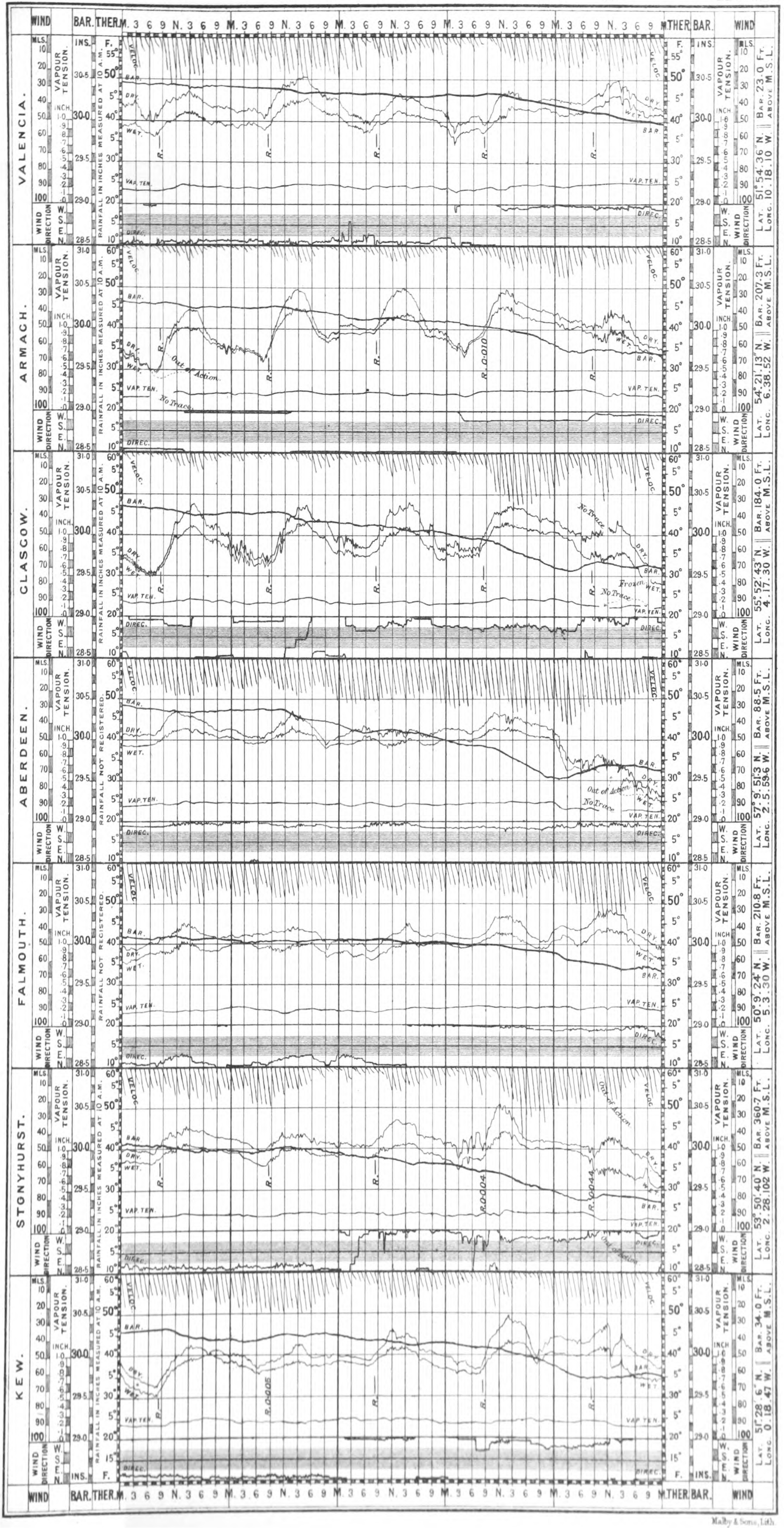
MARCH, _1870.

7TH. 8TH. 9TH. 10TH. 11TH.

Plate XIV.



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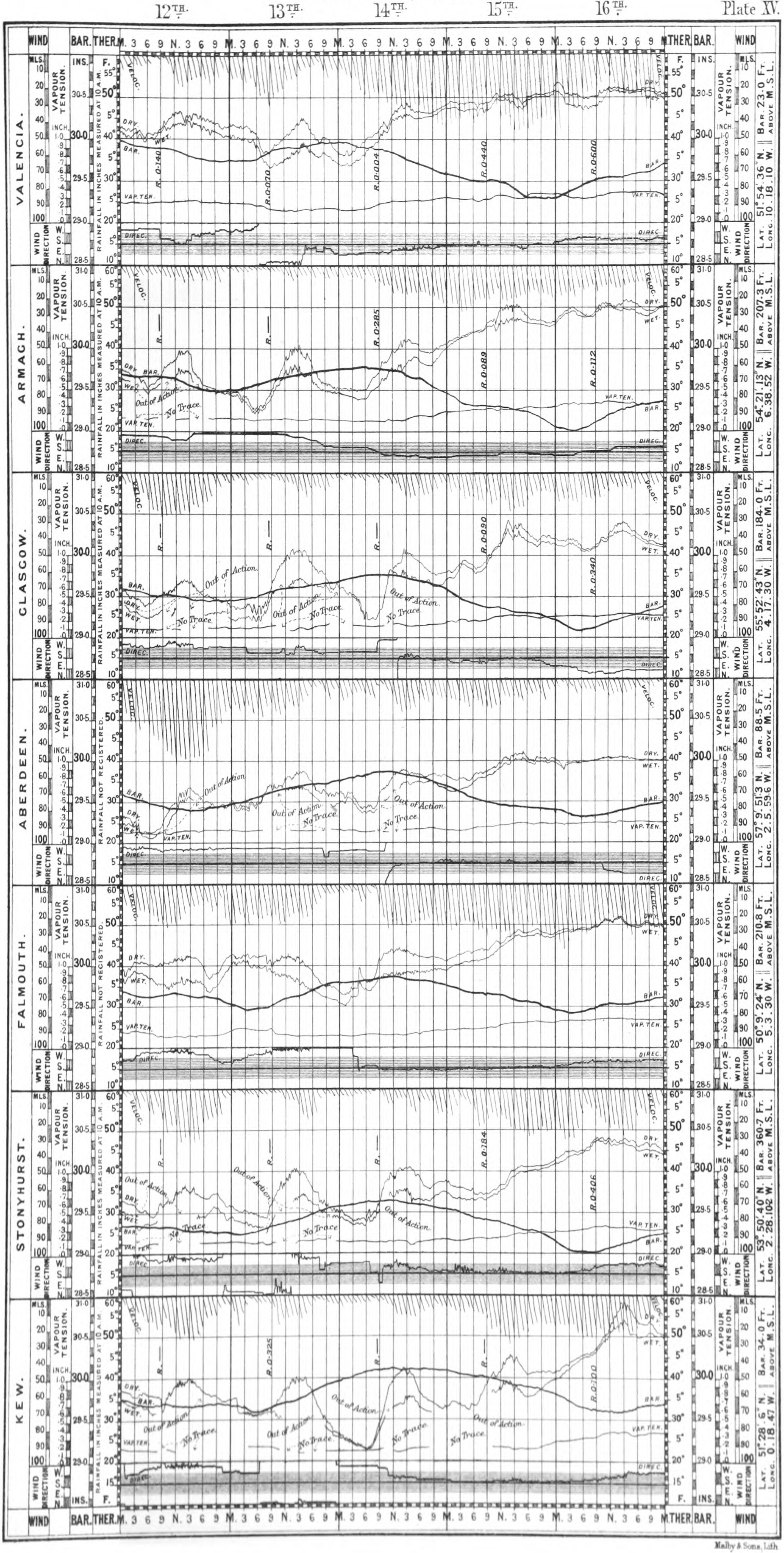
MARCH, _1870.



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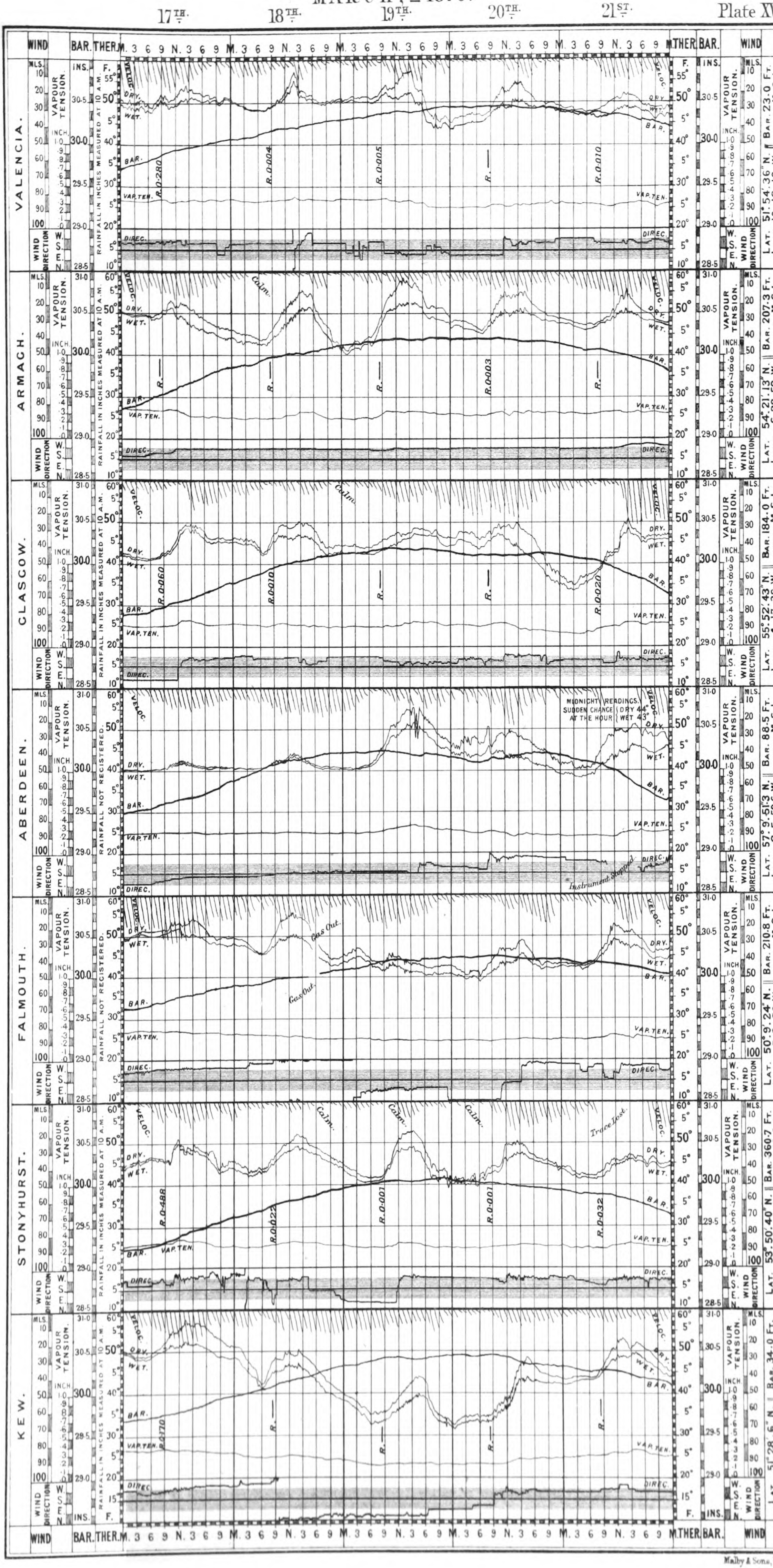
MARCH, _1870.

Plate XVI.



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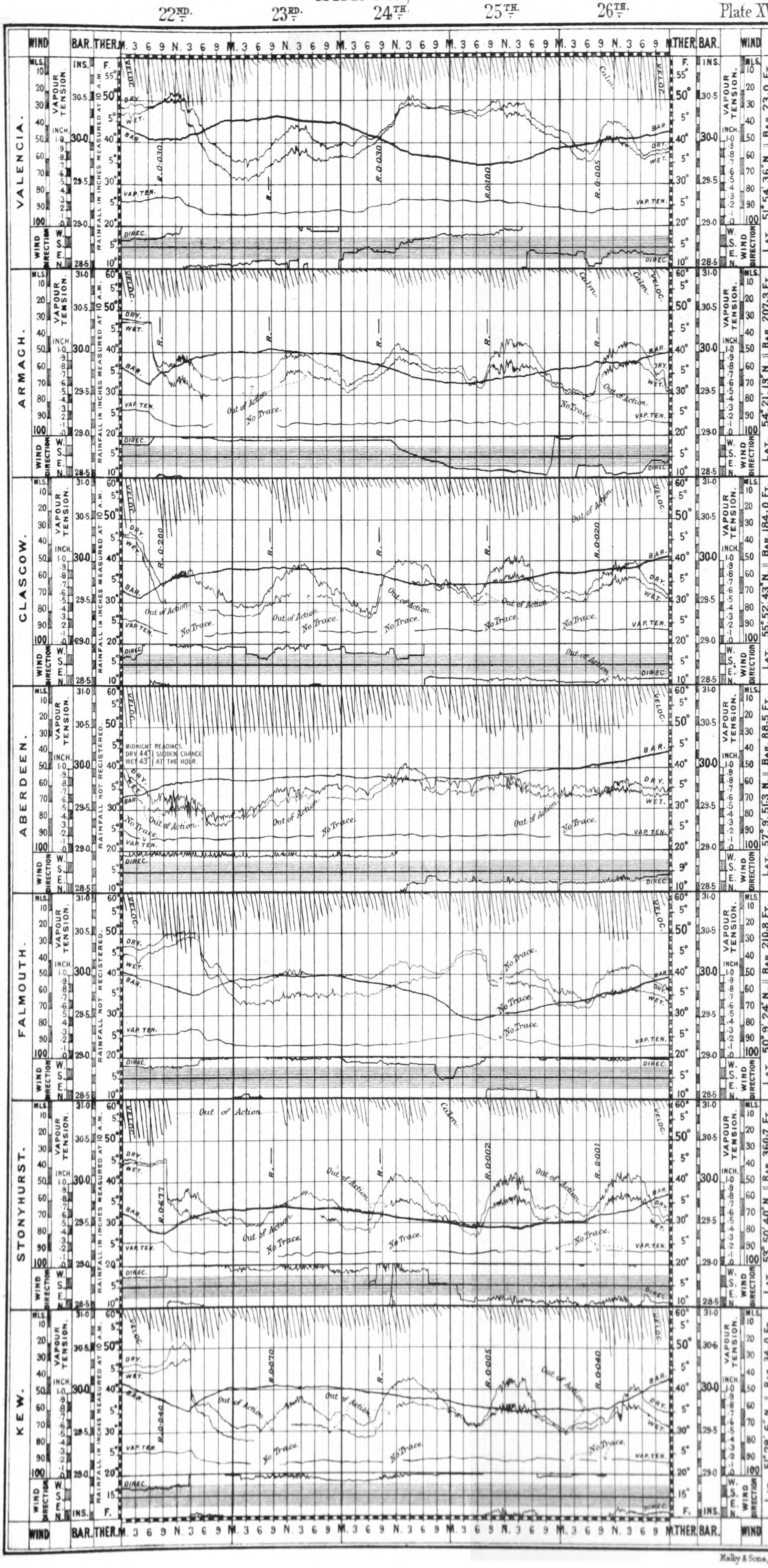
MARCH, 1870.

Plate XVII.



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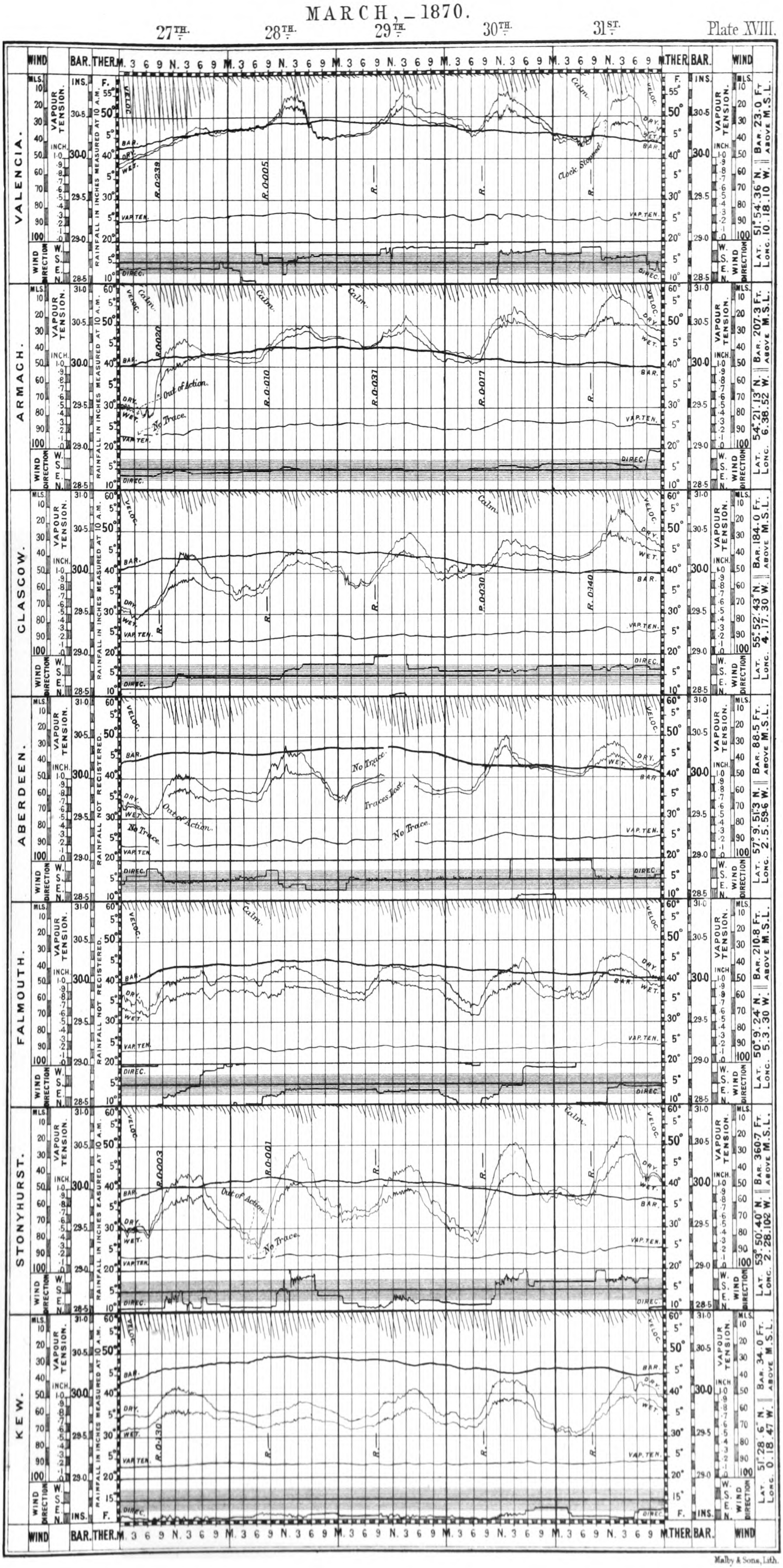
MARCH, _1870.



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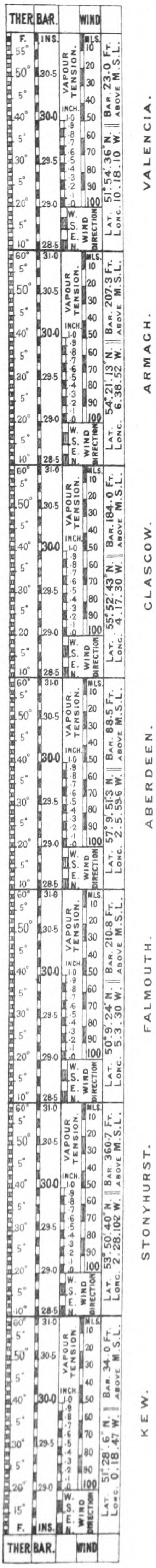
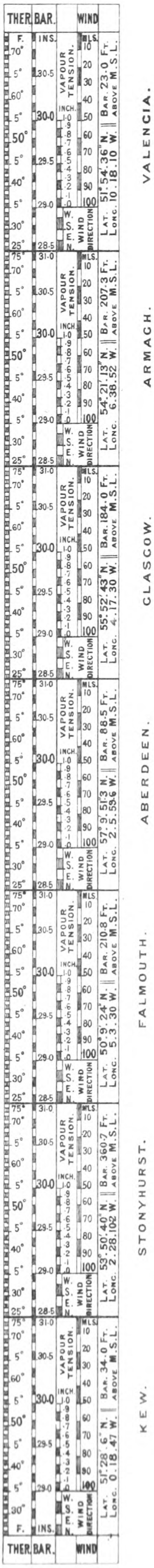

THER
BAR.
WIND
F.
INS.
MLS.
VAPOUR TENSION.
INCH.
WIND DIRECTION
KEW.
LAT. 51°28'6" N. LONG. 0.18.47 W. BAR. 34.0 FT. ABOVE M.S.L.
STONYHURST.
LAT. 53°50'40" N. LONG. 2.28.102 W. BAR. 360.7 FT. ABOVE M.S.L.
FALMOUTH.
LAT. 50°9'24" N. LONG. 5.3.30 W. BAR. 210.8 FT. ABOVE M.S.L.
ABERDEEN.
LAT. 57°9'51.3 N. LONG. 2.5.59.6 W. BAR. 88.5 FT. ABOVE M.S.L.
GLASGOW.
LAT. 55°52'43" N. LONG. 4.17.30 W. BAR. 184.0 FT. ABOVE M.S.L.
ARMAGH.
LAT. 54°21'13" N. LONG. 6.38.52 W. BAR. 207.3 FT. ABOVE M.S.L.
VALENCIA.
LAT. 51°54'36" N. LONG. 10.18.10 W. BAR. 23.0 FT. ABOVE M.S.L.

For Plates I to XVIII, Part I.


THER
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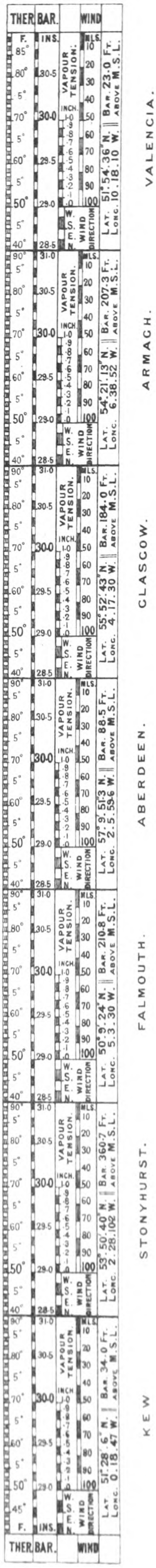
INCH.
WIND DIRECTION
KEW.
STONYHURST.
FALMOUTH.
ABERDEEN.
GLASGOW.
ARMAGH.
VALENCIA.

For all Plates in Part II, except XXIX, XXXIV & XXXV.


THER
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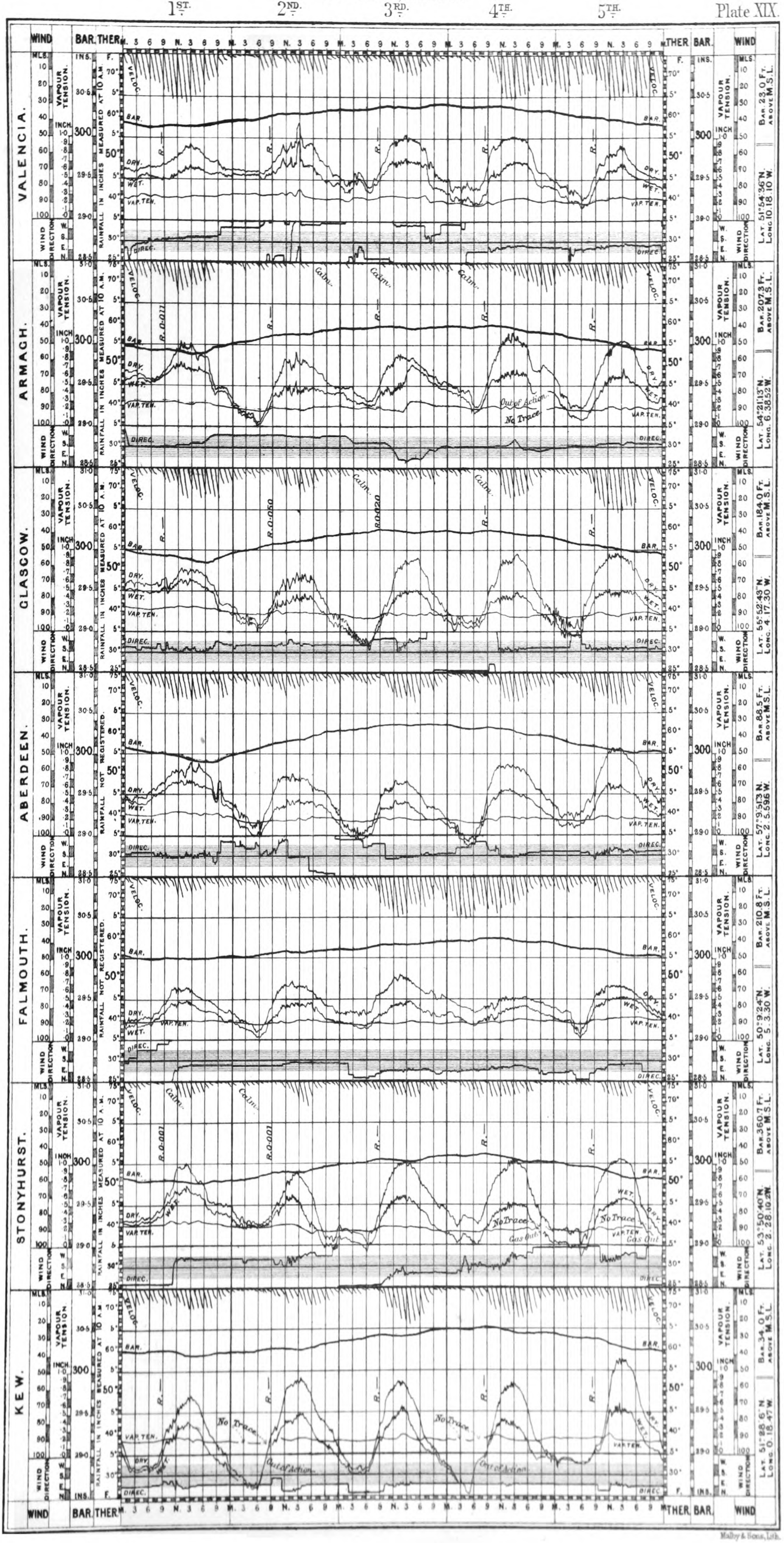
MLS.
VAPOUR TENSION.
INCH.
WIND DIRECTION
KEW
STONYHURST.
FALMOUTH.
ABERDEEN.
GLASGOW.
ARMAGH.
VALENCIA.

For Plates XXIX, XXXIV & XXXV.

These Scales may be Cut out and used in Measuring the Curves.

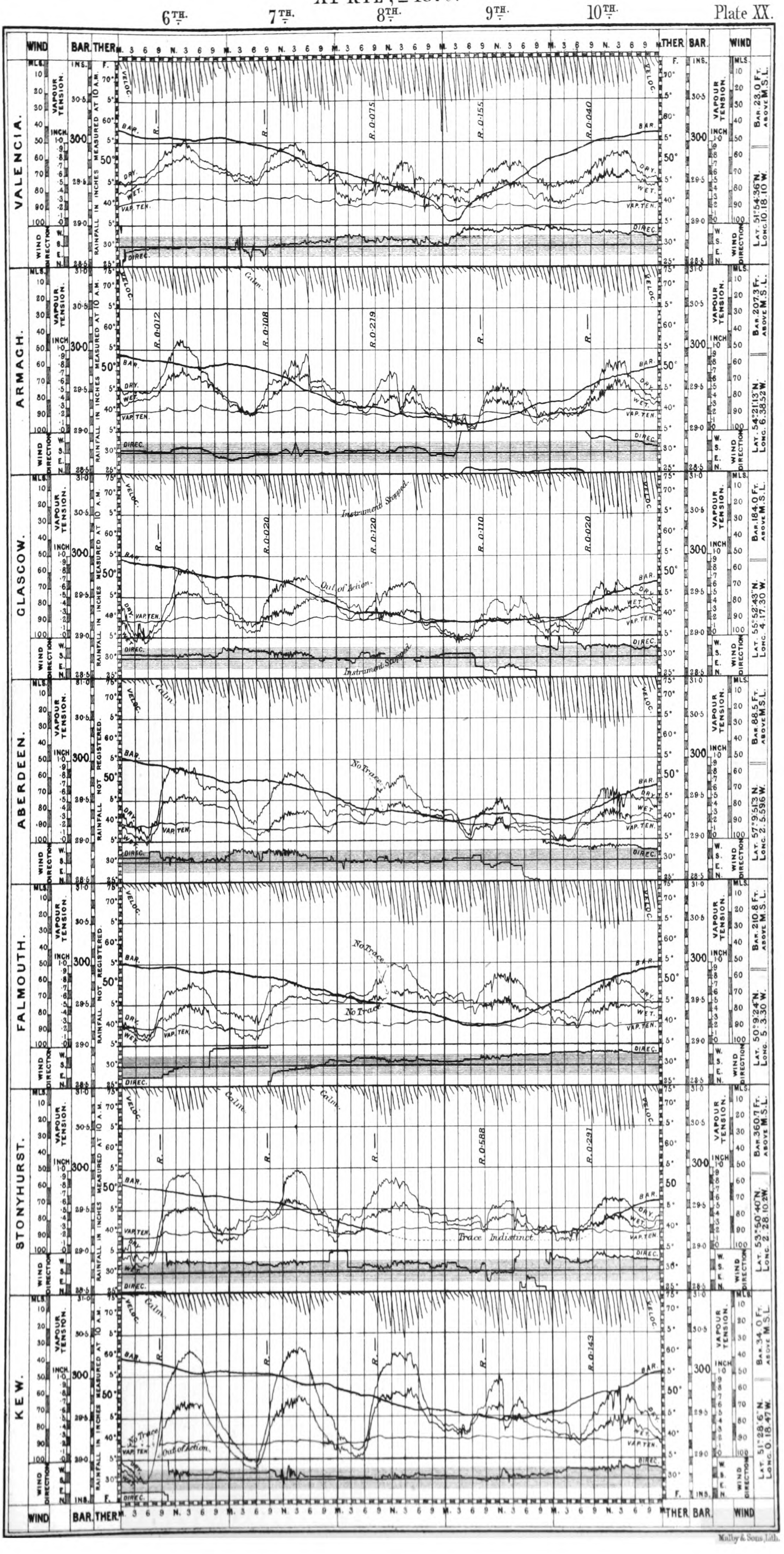
APRIL, _1870.

Plate XIX.



Malby & Sons, Lith.

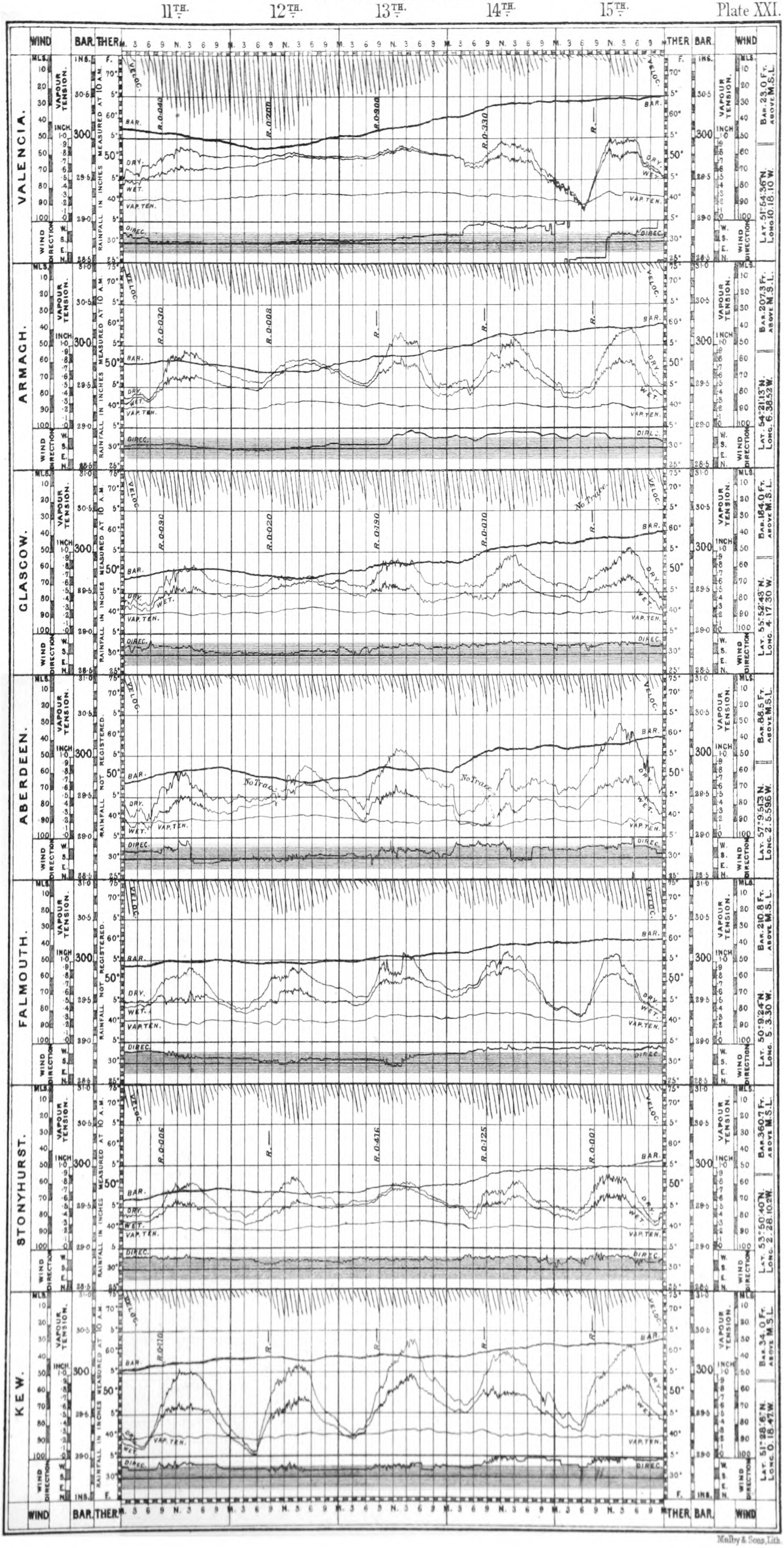
APRIL, _1870.



Malby & Sons, Lith.

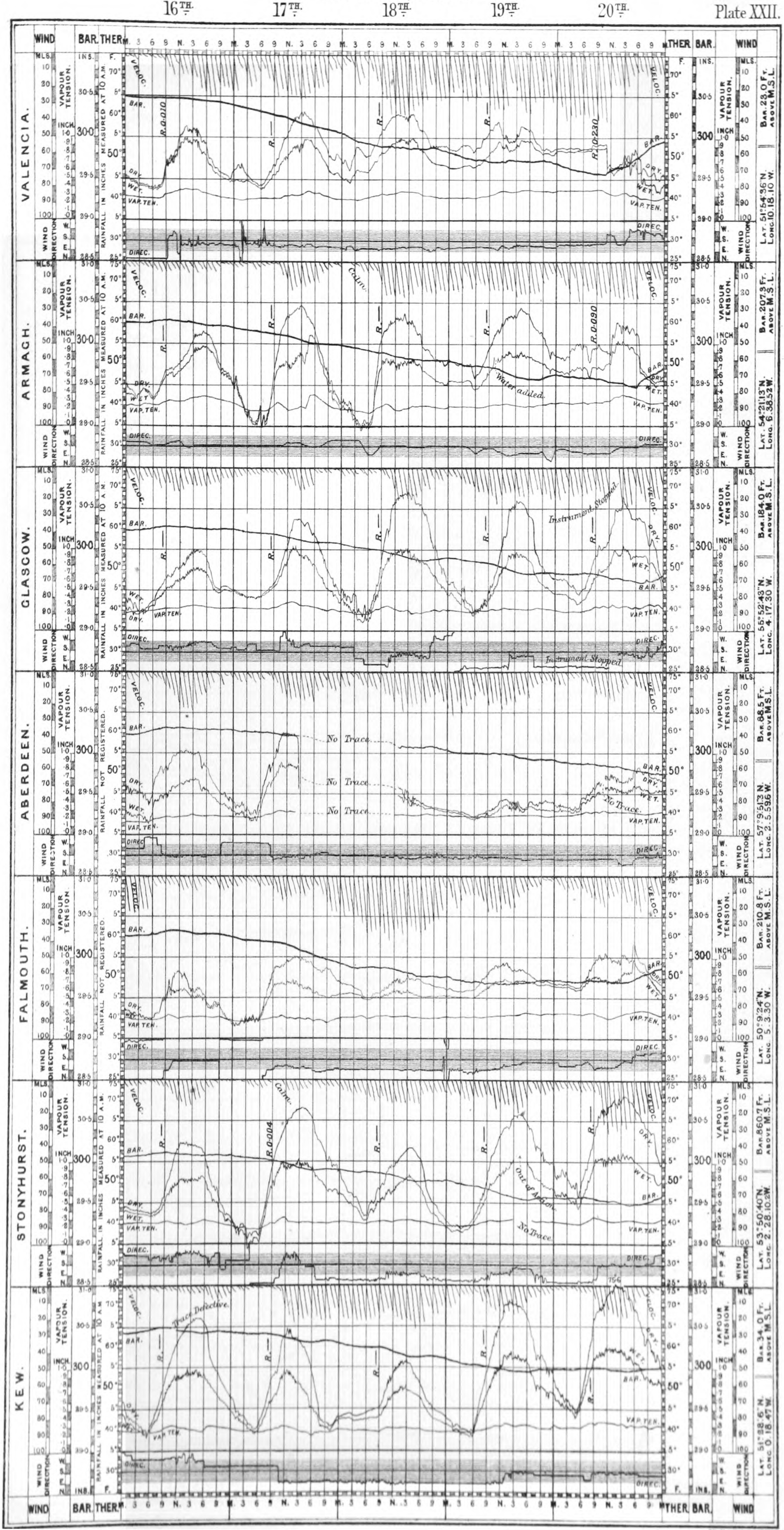
APRIL, _1870.

Plate XXI.



Malby & Sons, Lith.

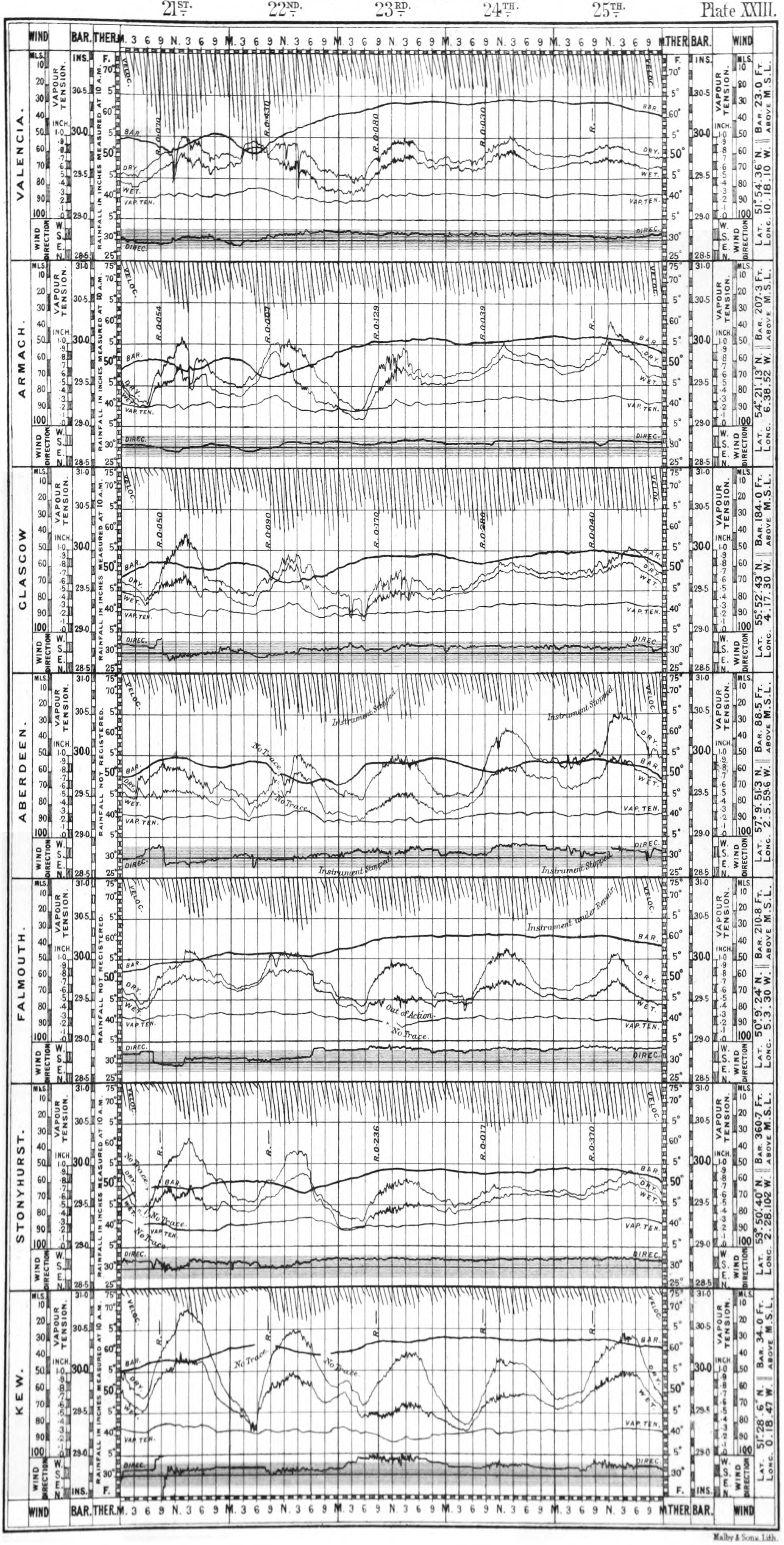
APRIL, _1870.



Malby & Sons, Lith.

APRIL, 1870.

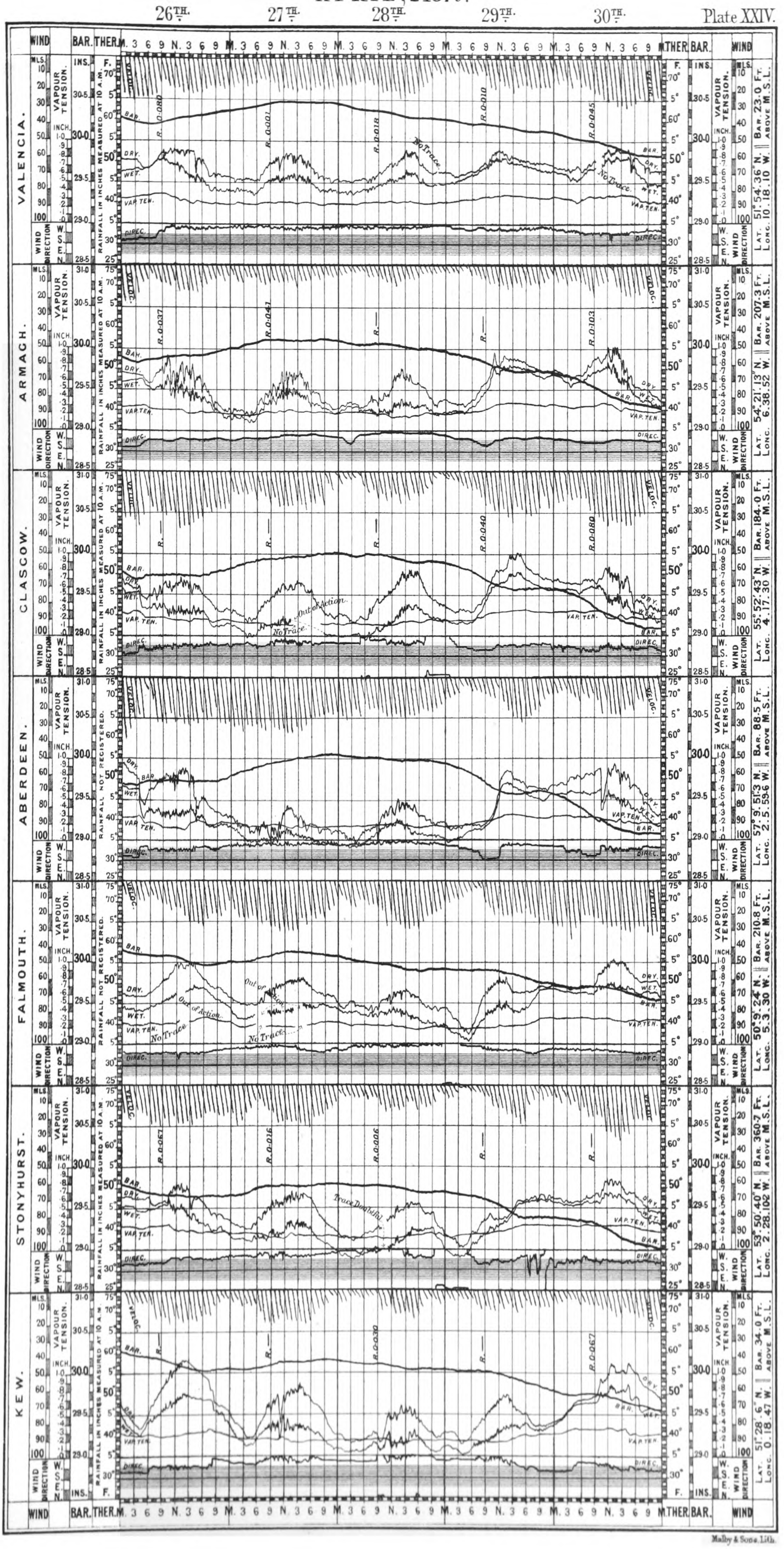
Plate XXIII.



Malby & Sons, Lith.

APRIL, 1870.

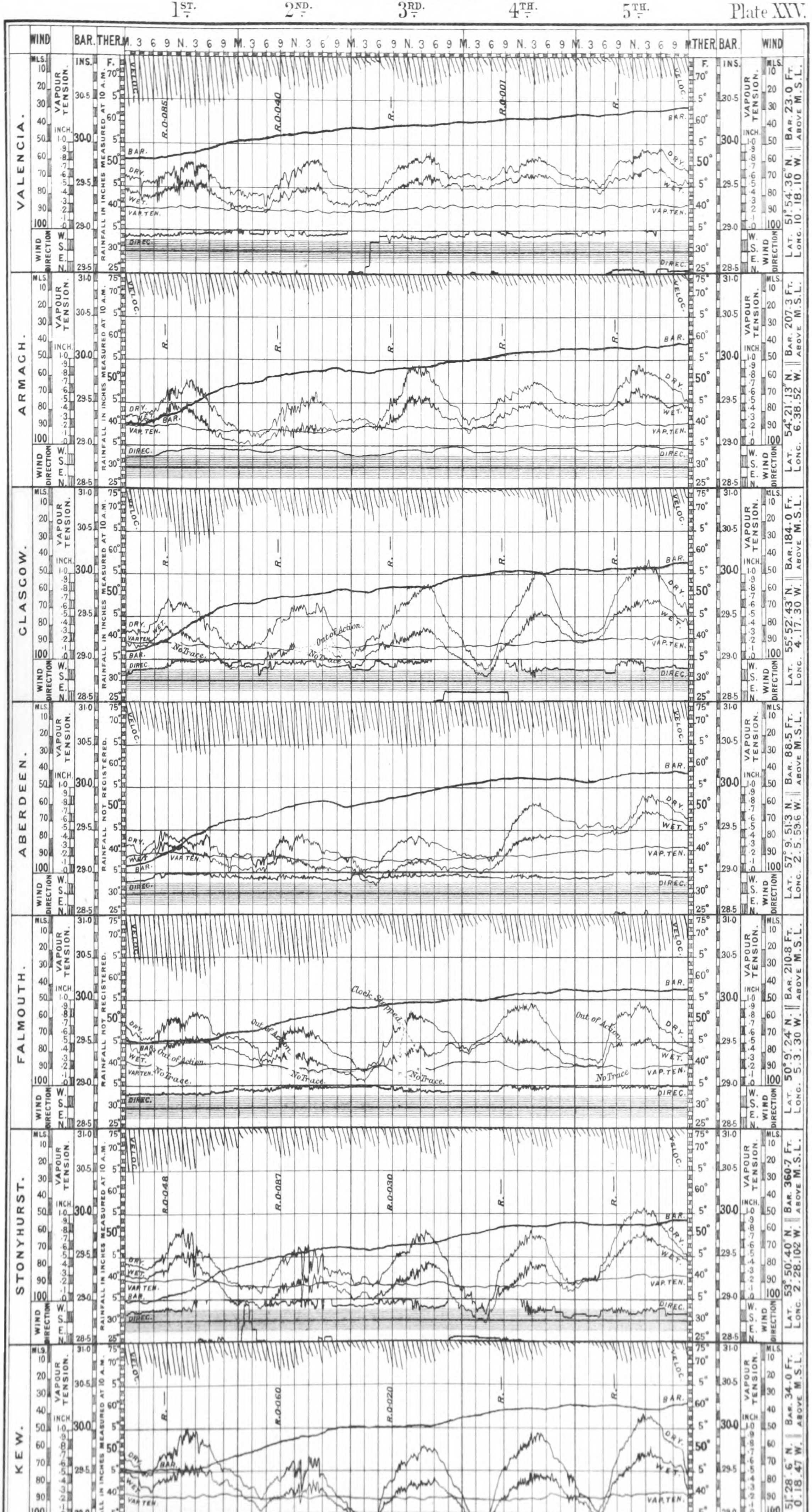
Plate XXIV.



Malby & Sons. Lith.

MAY, _1870.

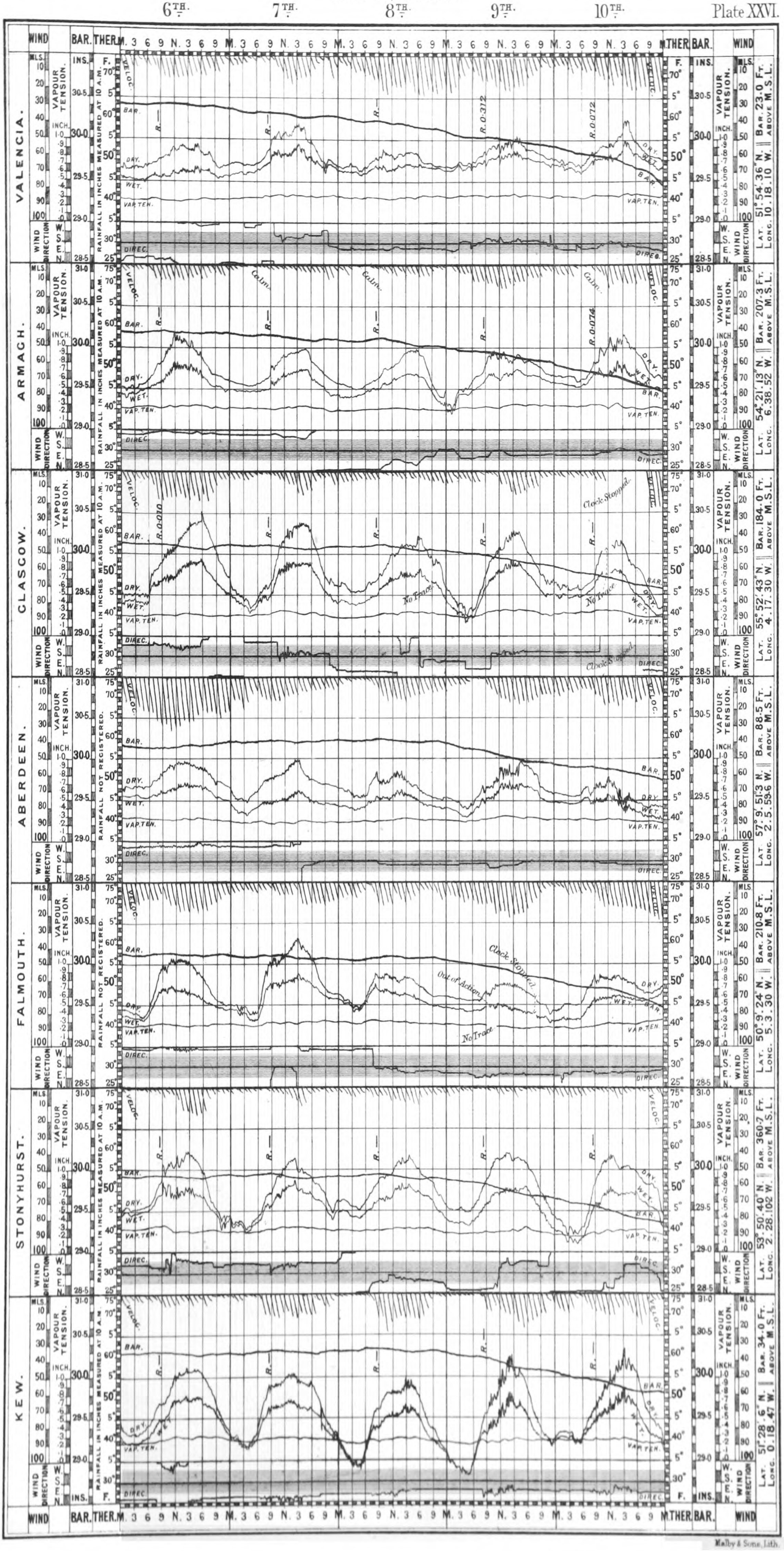
Plate XXV.



Malby & Sons, Lith.

MAY, _1870.

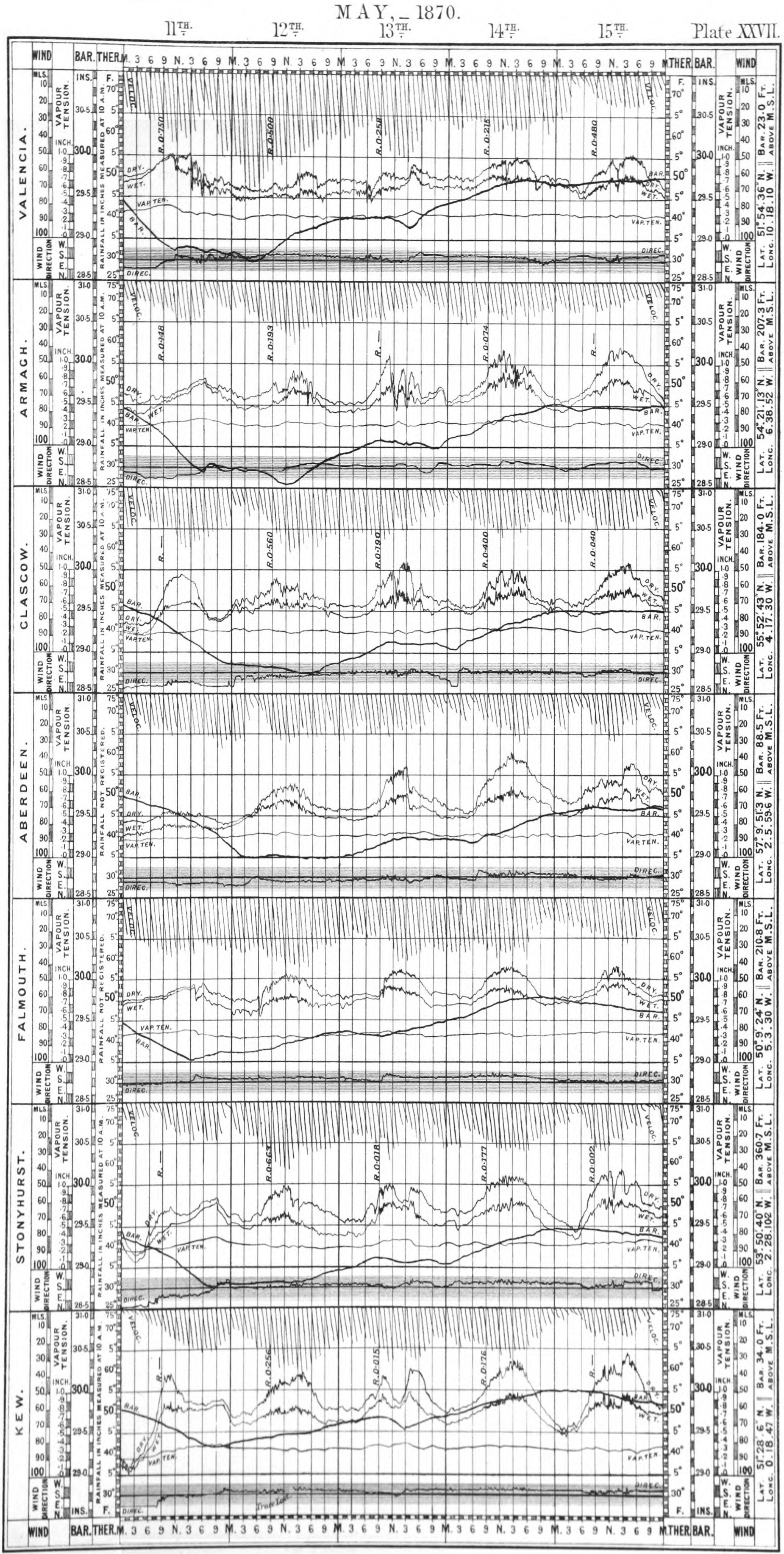
Plate XXVI.



Malby & Sons, Lith.

MAY, _ 1870.

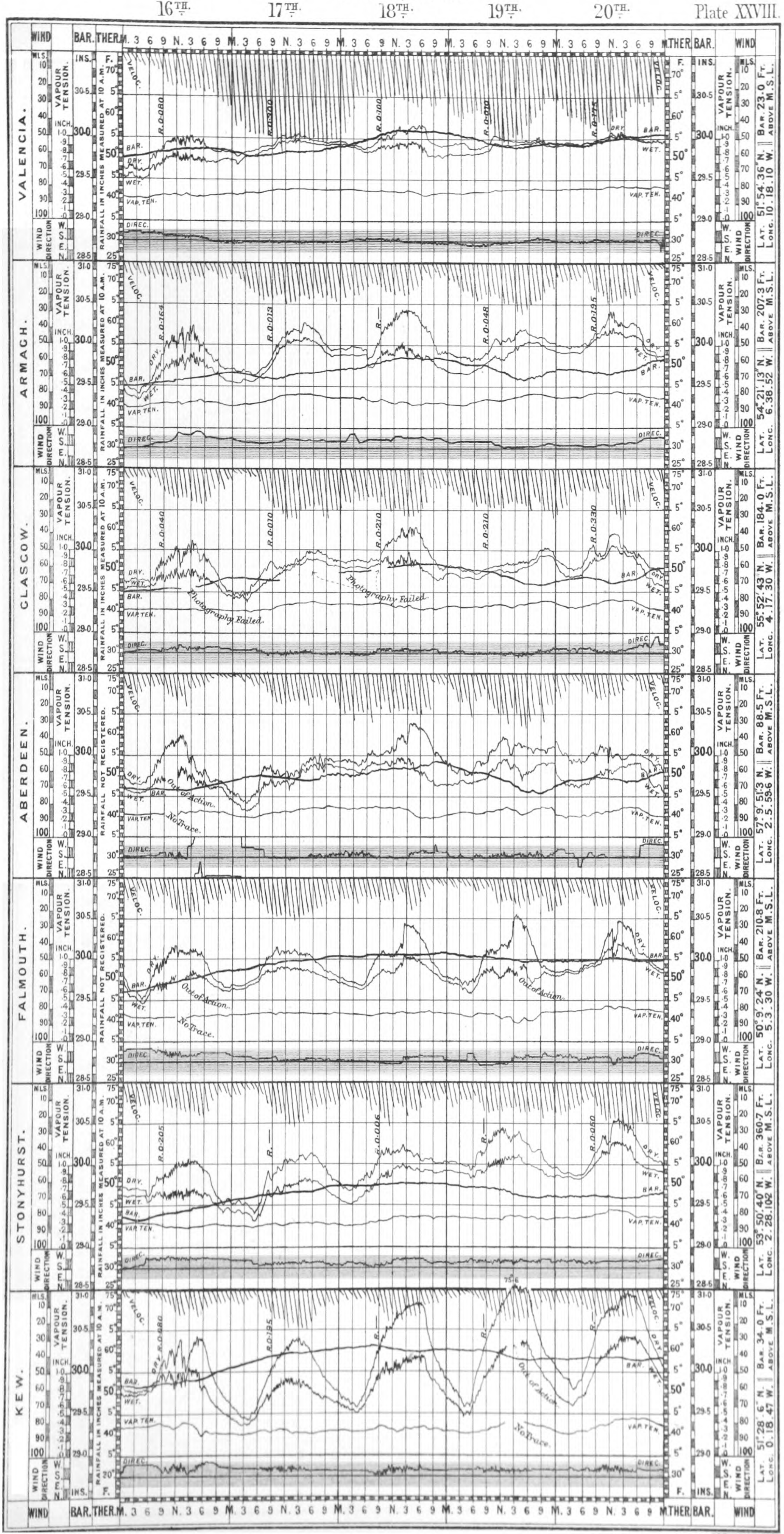
Plate XXVII.



Malby & Sons, Lith.

MAY, 1870.

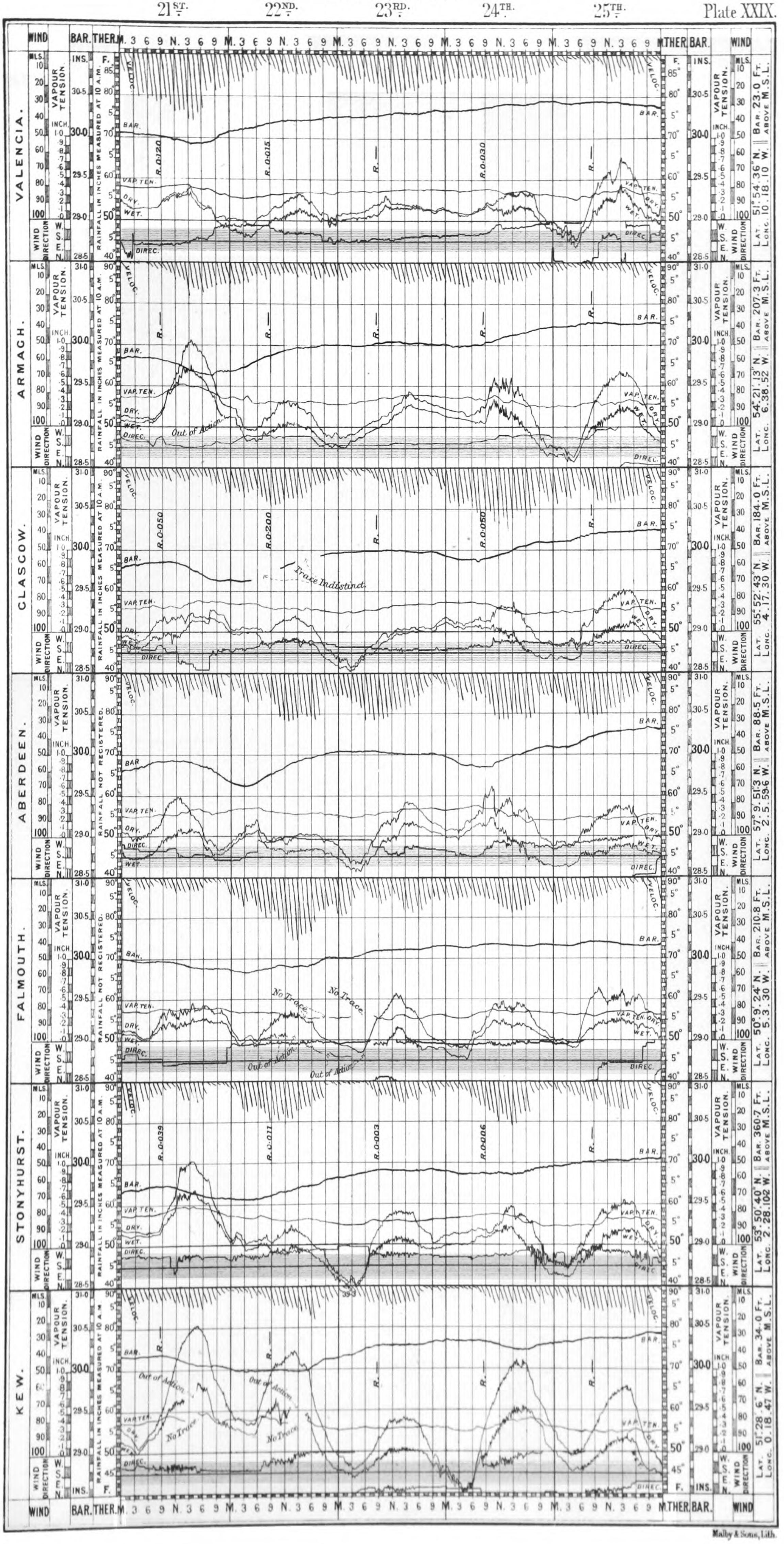
Plate XXVIII.



Malby & Sons, Lith.

MAY, — 1870.

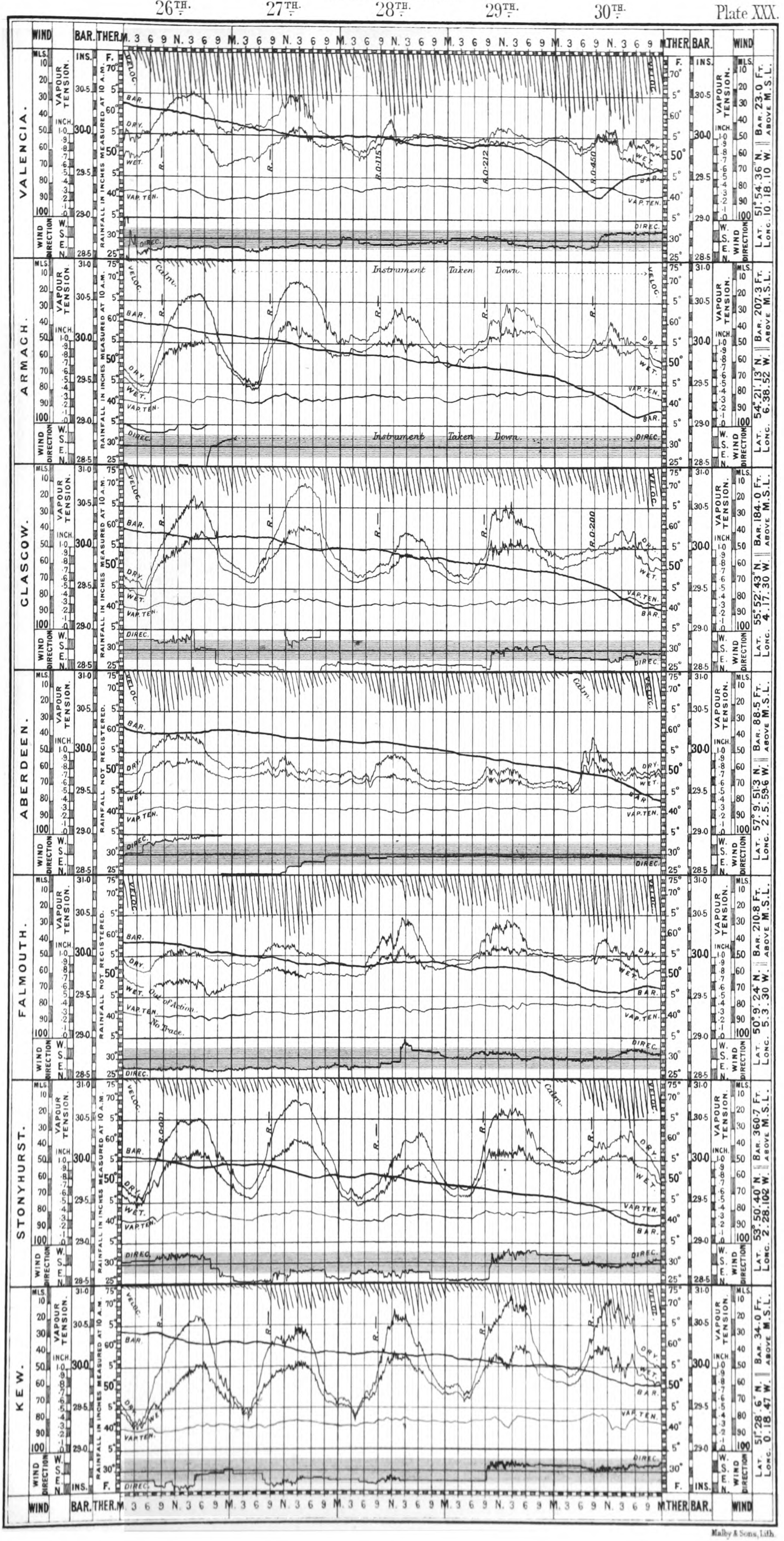
Plate XXIX.



Malby & Sons, Lith.

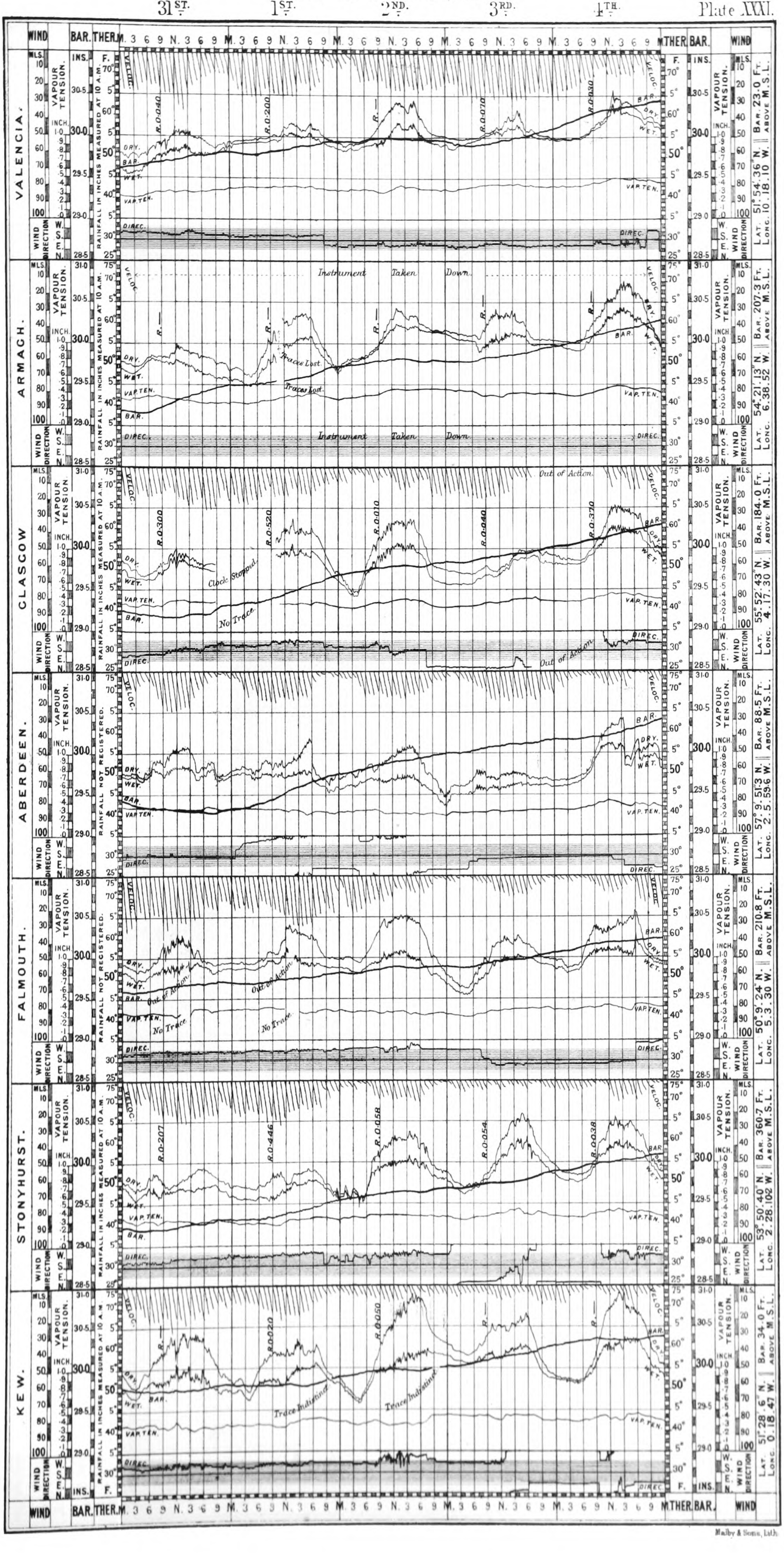
MAY, _ 1870.

Plate XXX.



Malby & Sons, Lith.

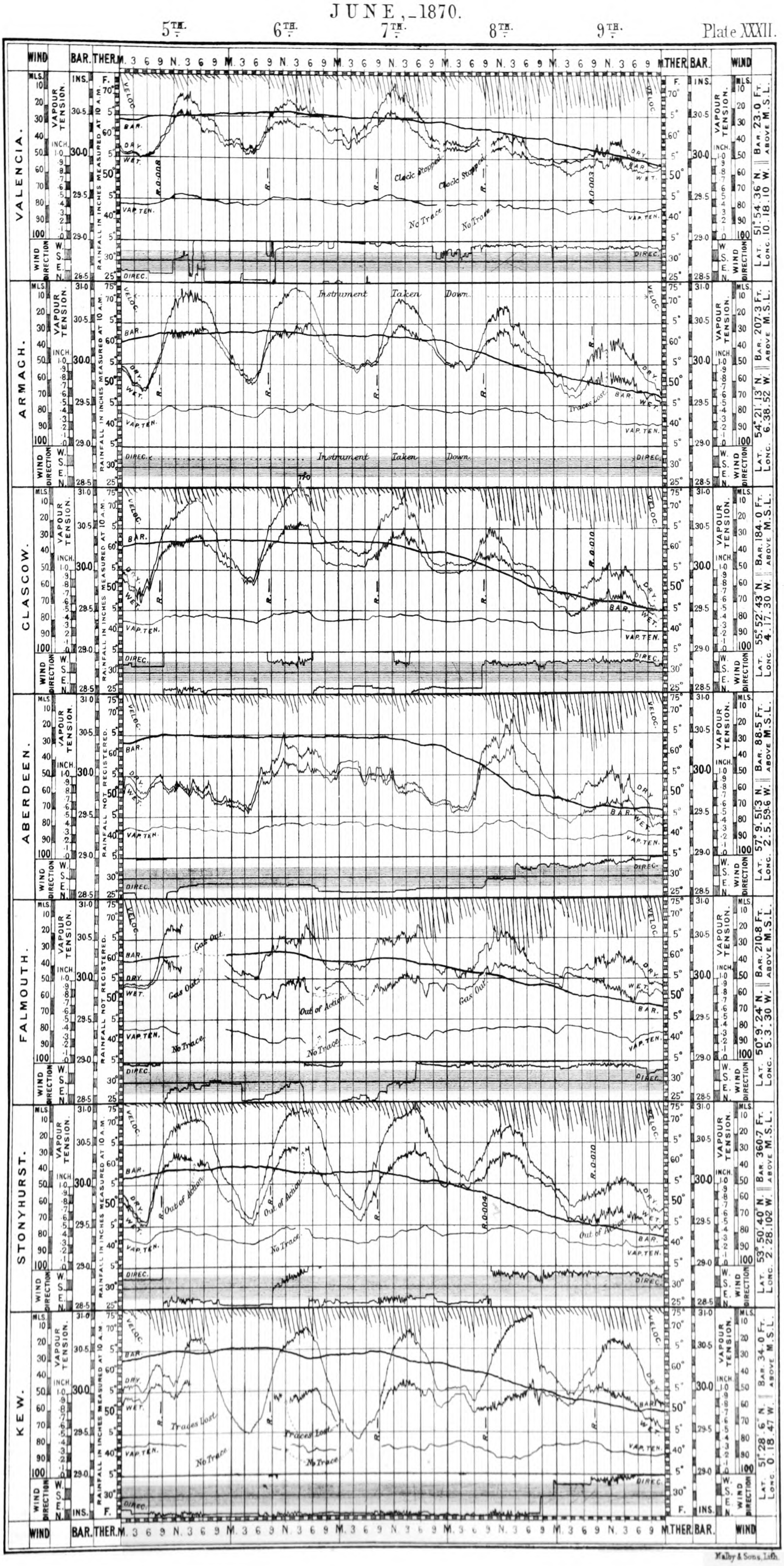
MAY & JUNE, 1870.



Malby & Sons, Lith.

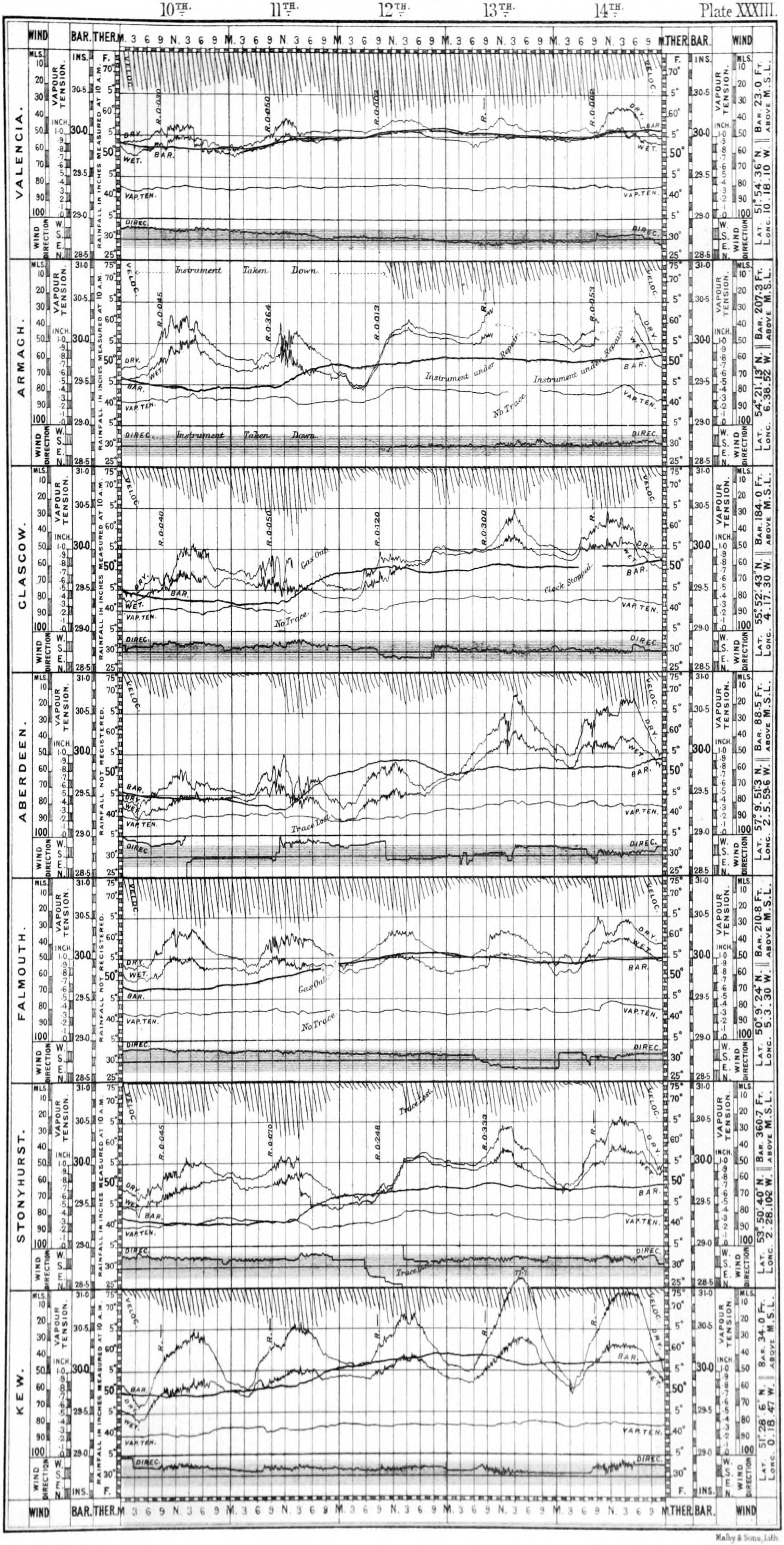
JUNE, 1870.

Plate XXXII.



Malby & Sons, Lith.

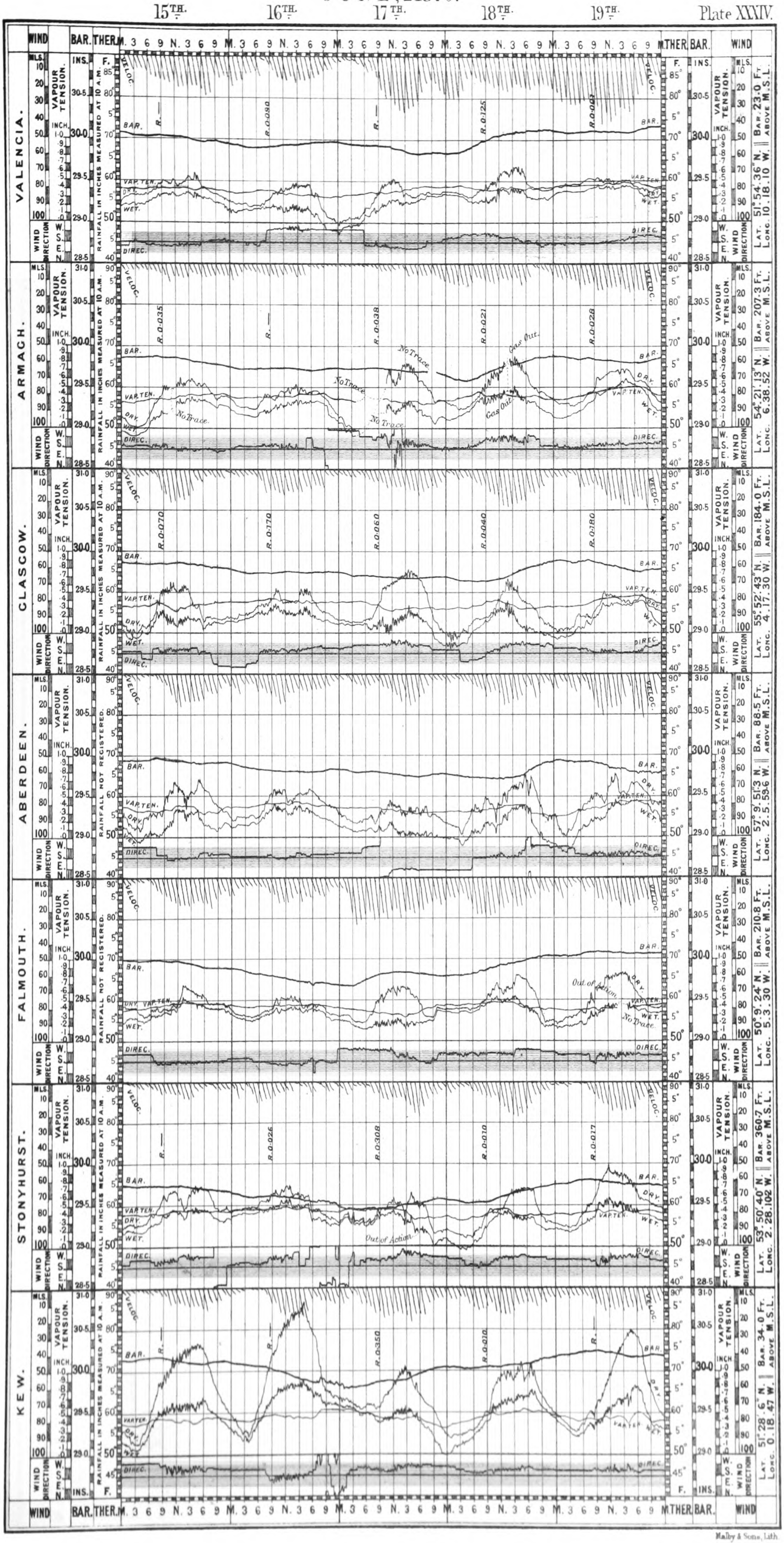
JUNE, _ 1870.



Malby & Sons, Lith.

JUNE, 1870.

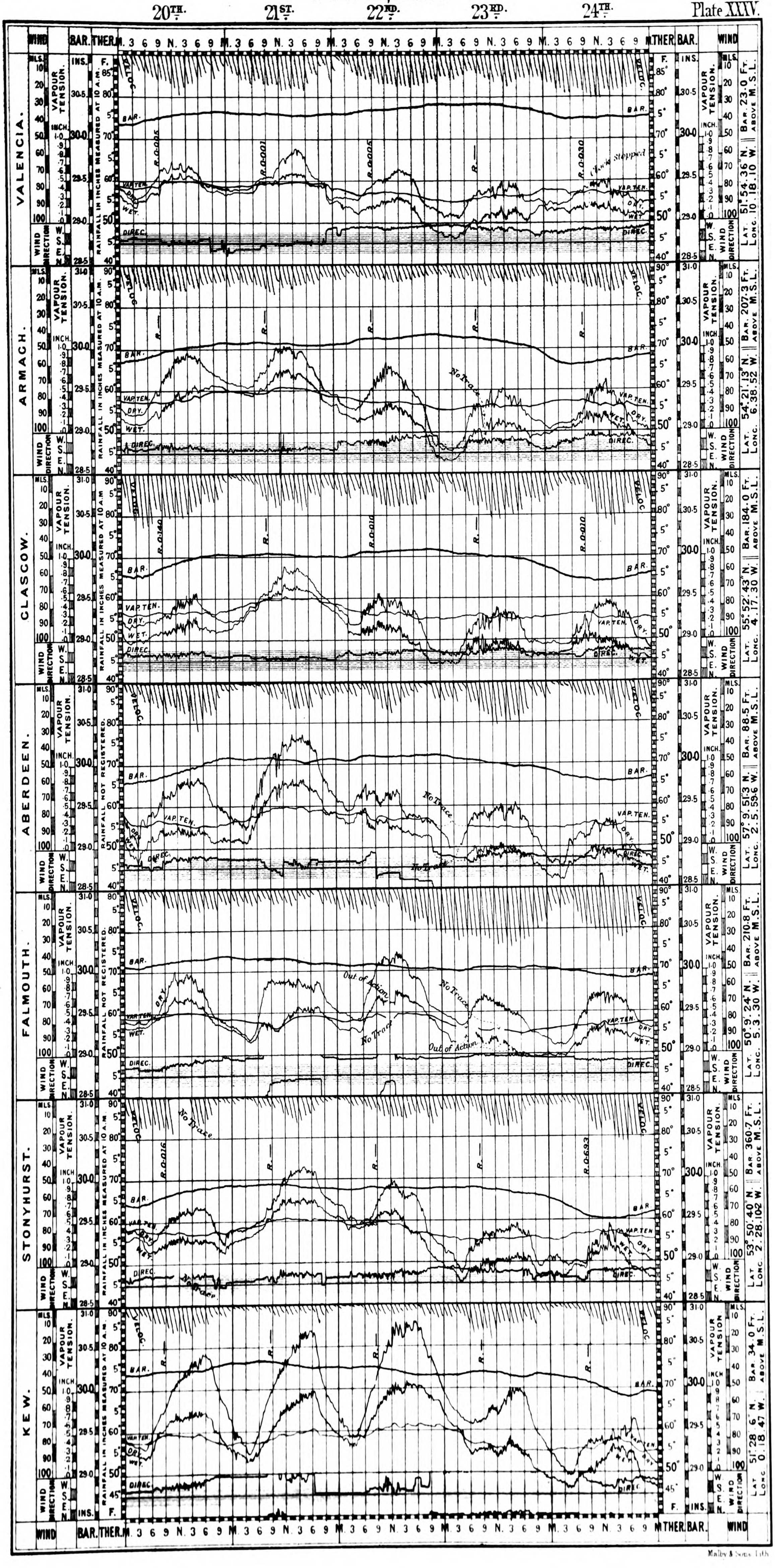
Plate XXXIV.



Maltby & Sons, Lith.

JUNE, -1870.

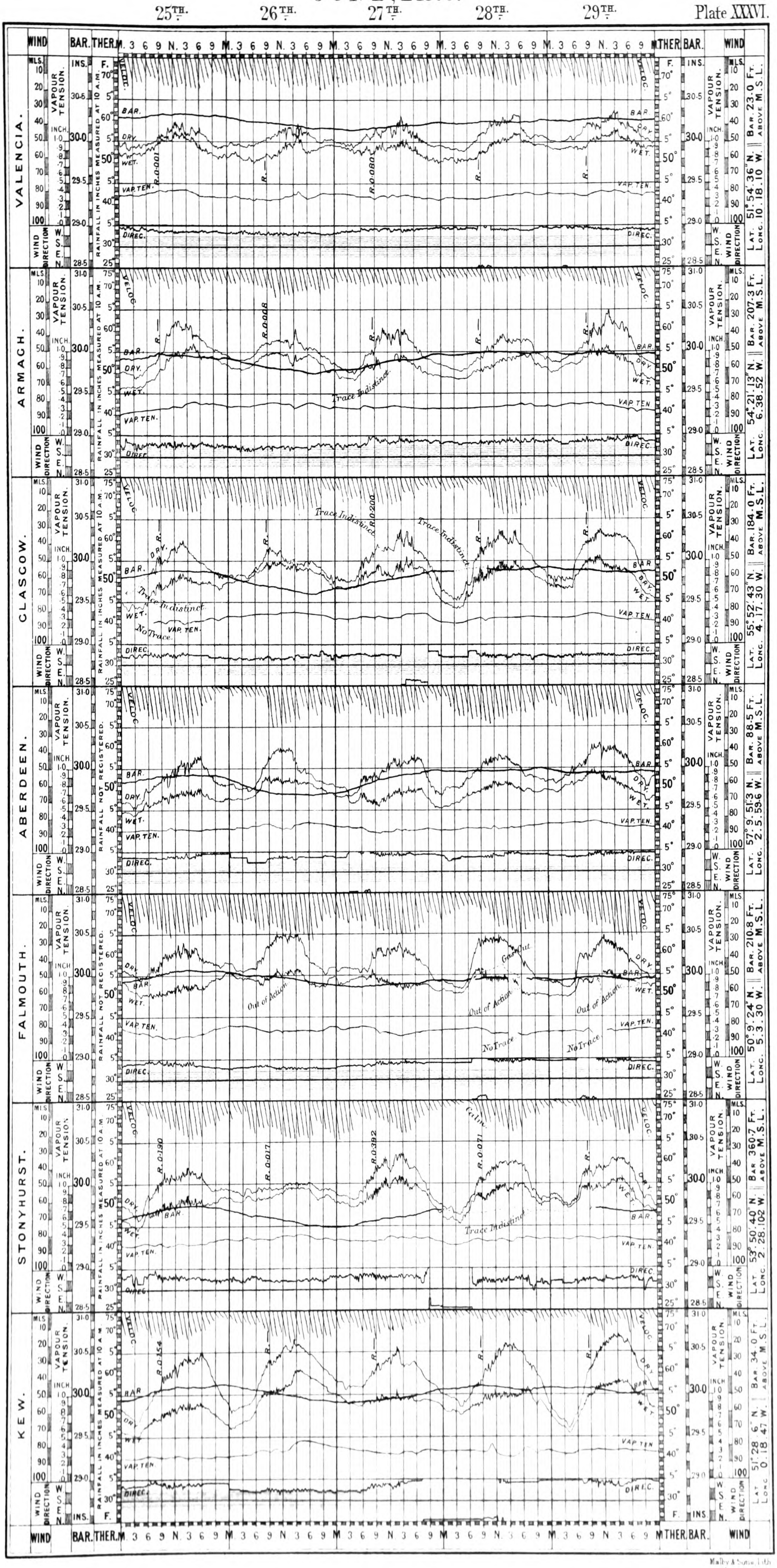
Plate XXXV.



Malby & Sons Lith.

JUNE, — 1870.

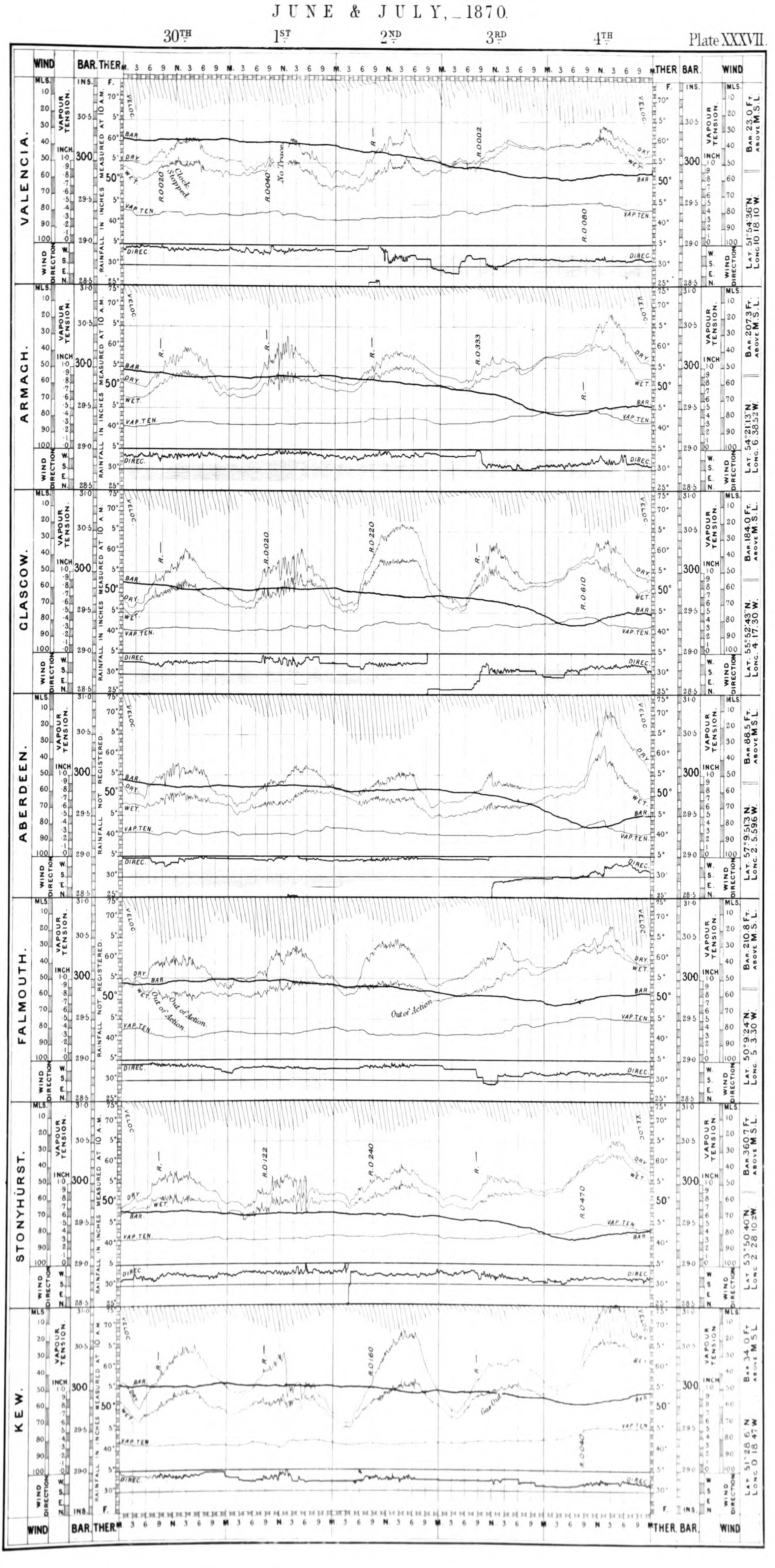
Plate XXXVI.



Malby & Sons, Lith.

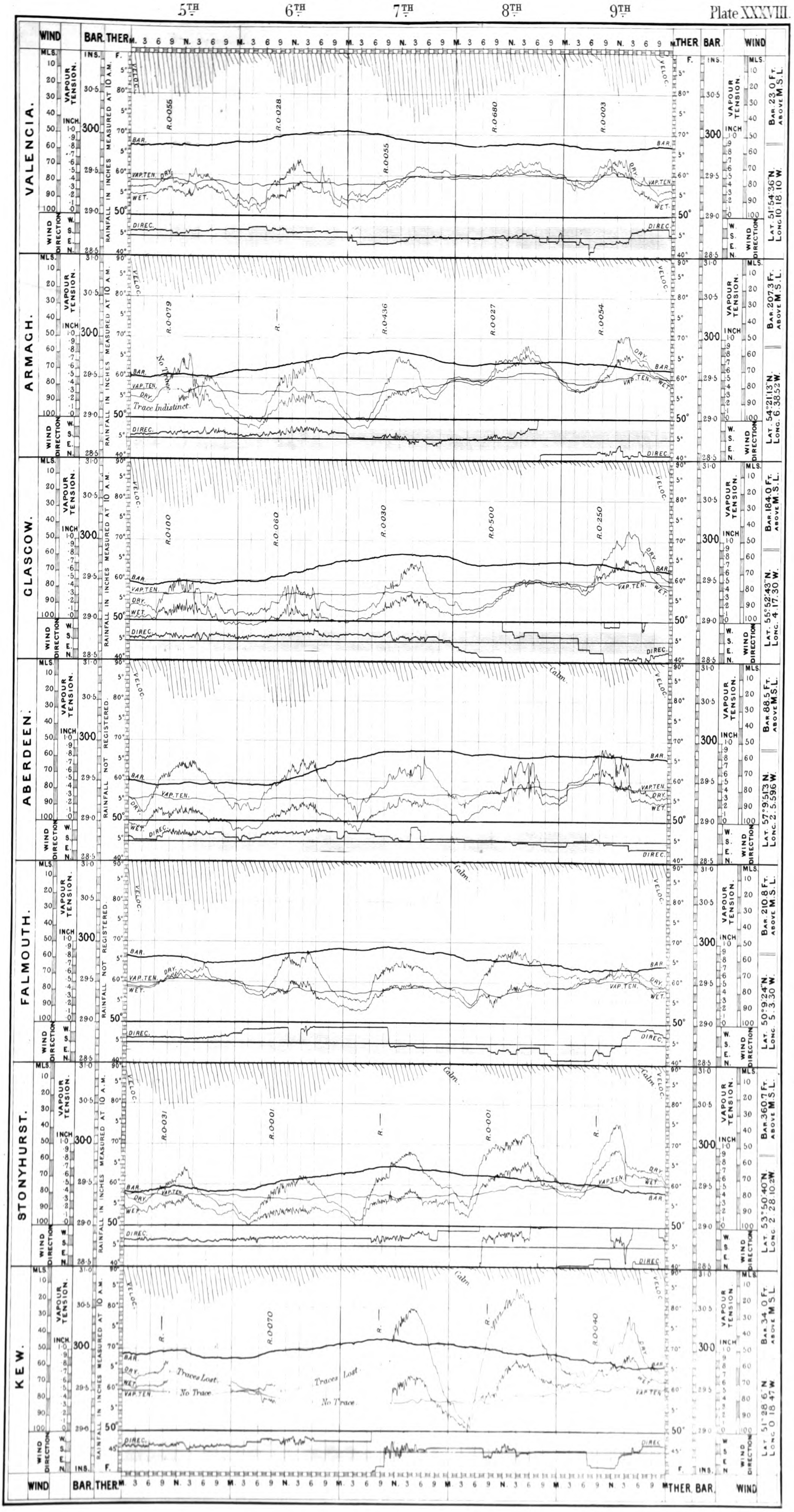
JUNE & JULY, _1870.

Plate XXXVII.



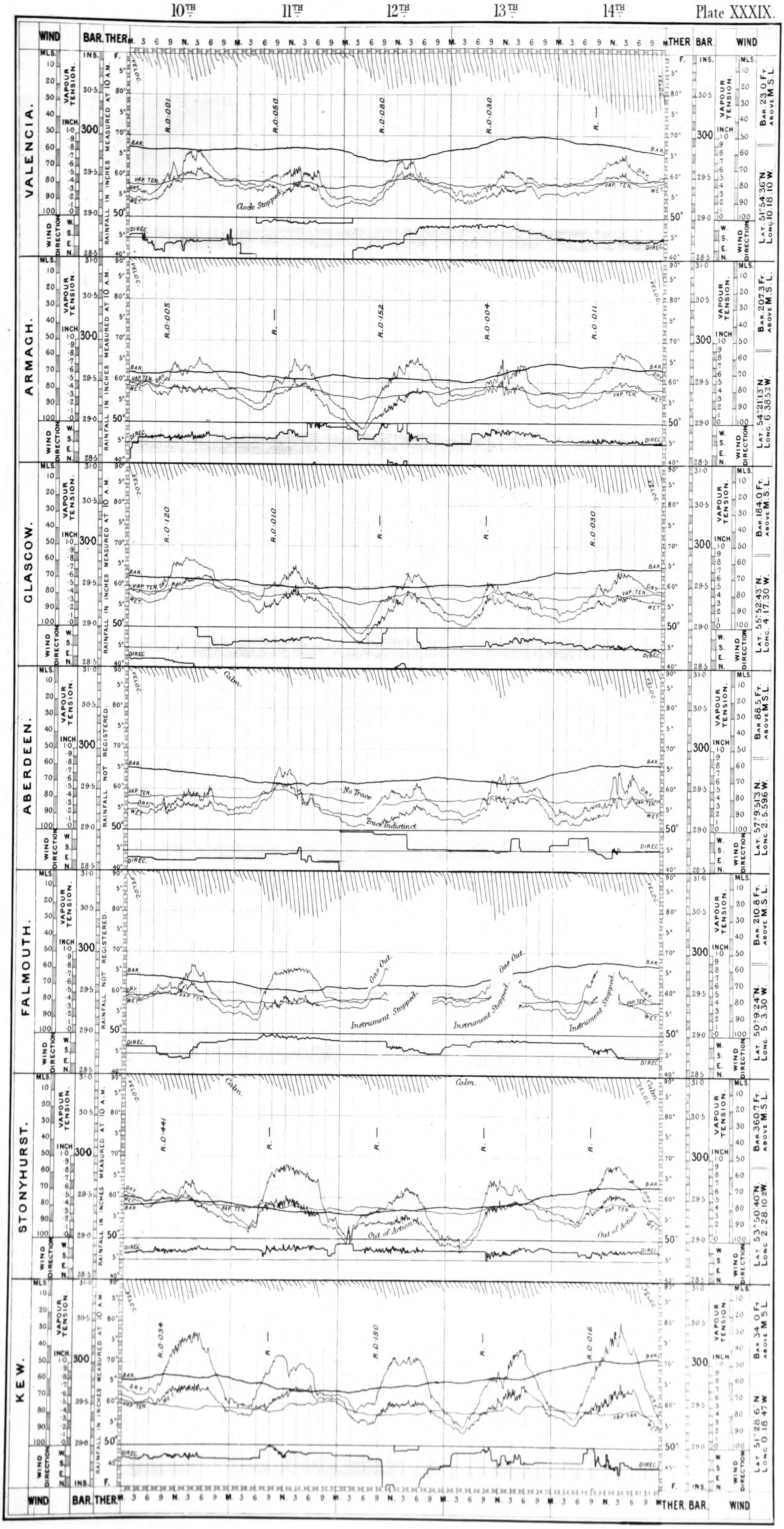
JULY, 1870.

Plate XXXVIII.



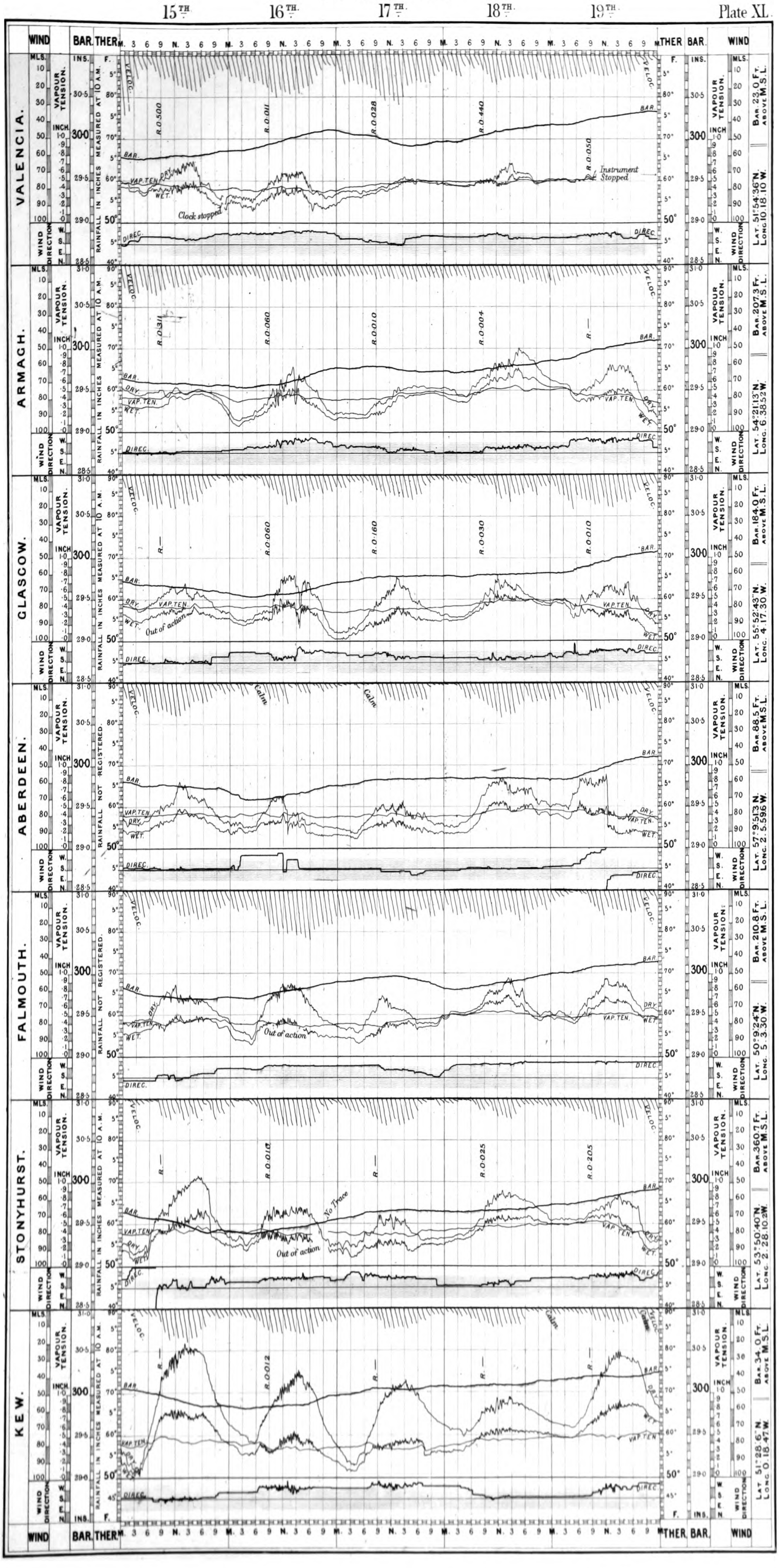
JULY, _ 1870

Plate XXXIX.

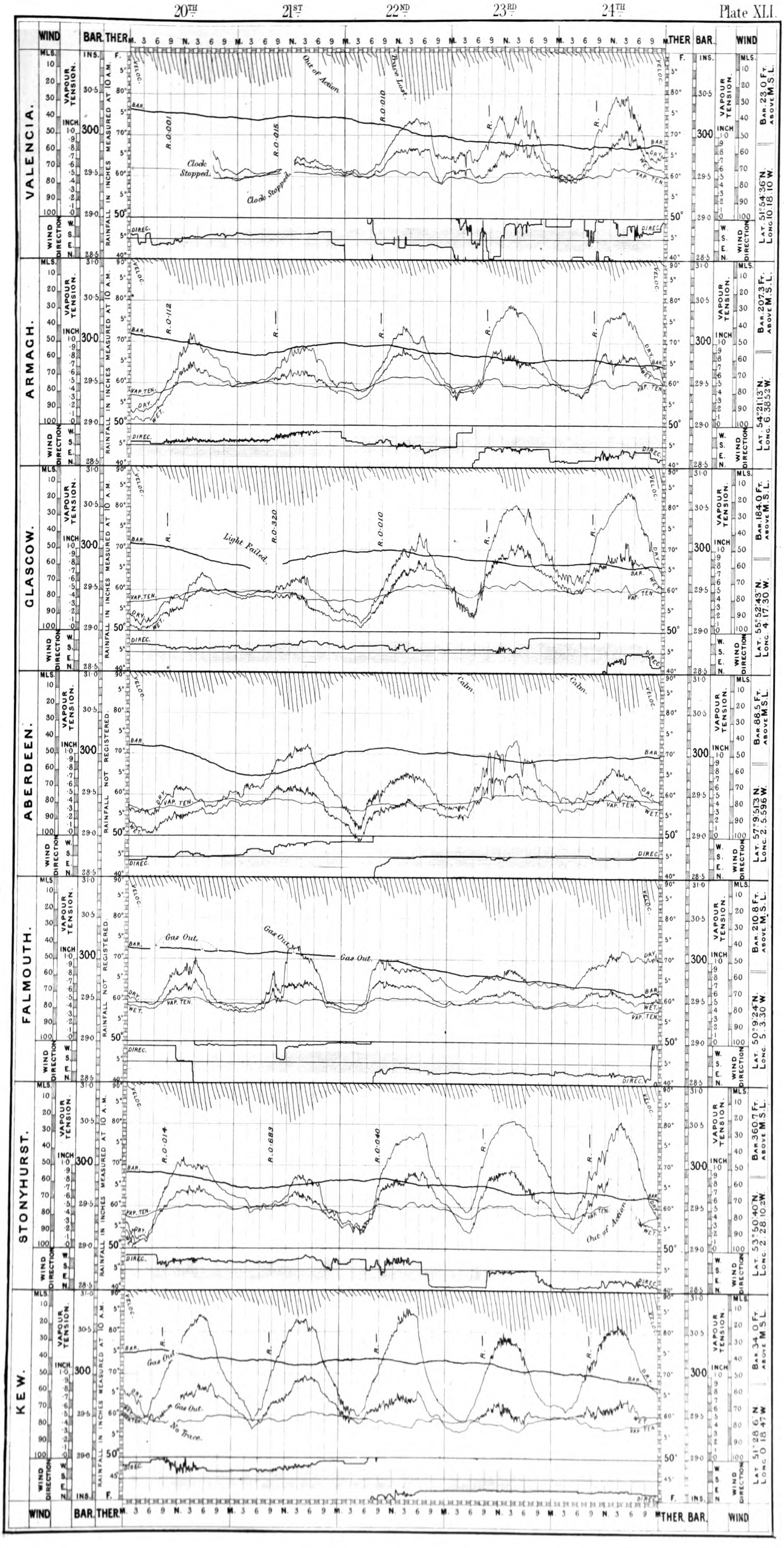


JULY, _ 1870

Plate XL.

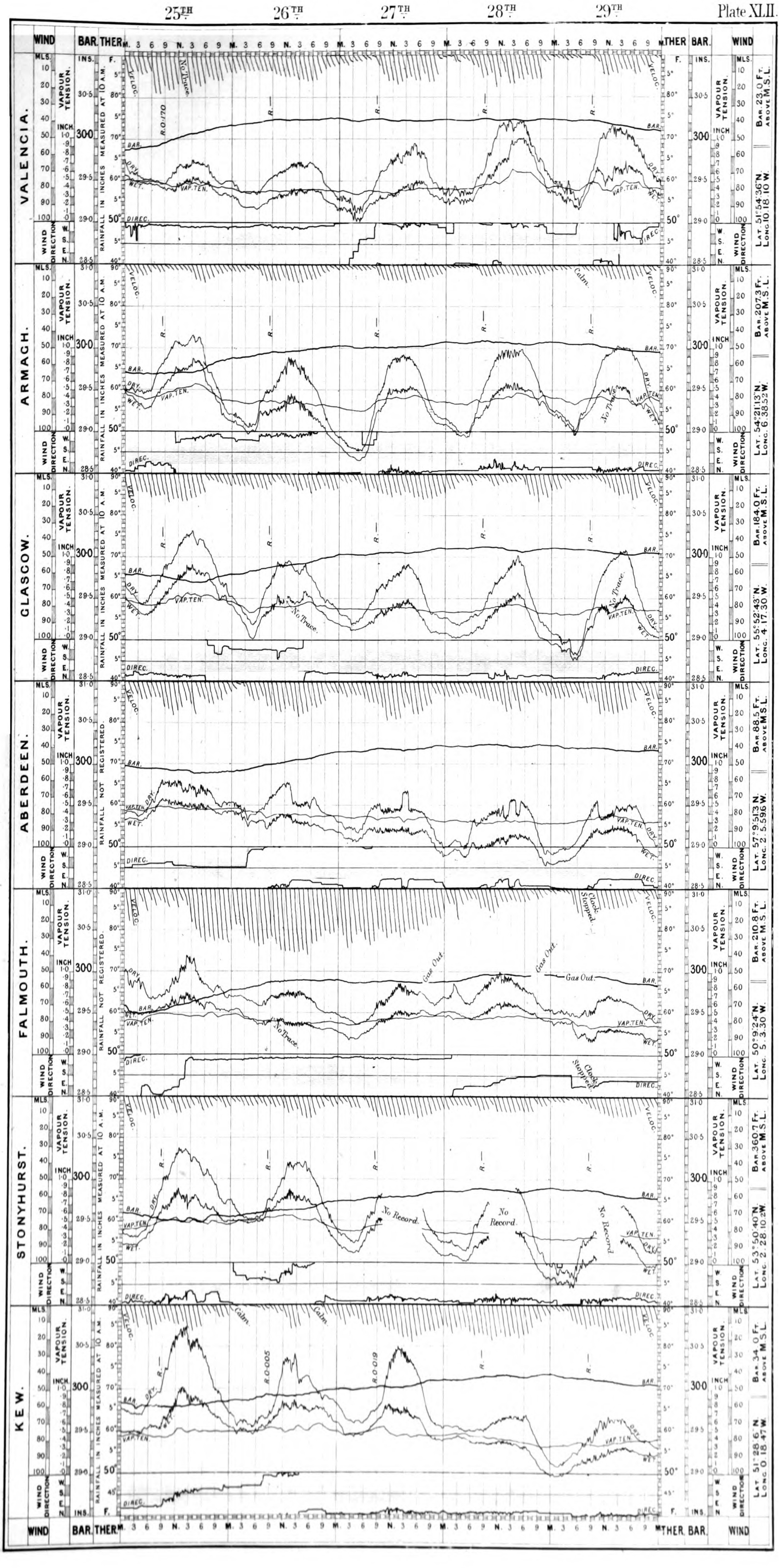


JULY, _1870.


20th
21st
22nd
23rd
24th
WIND
BAR.
THER.
M. 3 6 9 N. 3 6 9
VALENCIA.
Out of Action
Trace Lost.
R. 0·001
R. 0·015
R. 0·010
Clock Stopped.
Clock Stopped.
BAR.
DRY.
WET.
VAP. TEN.
DIREC.
VELOC.
Bar. 23.0 Ft. above M.S.L.
Lat. 51°54′36″N. Long. 10.18.10 W.
ARMAGH.
R. 0·112
Bar. 207.3 Ft. above M.S.L.
Lat. 54°21′13″N. Long. 6.38.52 W.
GLASGOW.
Light Failed.
R. 0·320
R. 0·010
Bar. 184.0 Ft. above M.S.L.
Lat. 55°52′43″N. Long. 4.17.30 W.
ABERDEEN.
RAINFALL NOT REGISTERED.
Calm.
Calm.
Bar. 88.5 Ft. above M.S.L.
Lat. 57°9′51″3 N. Long. 2.5.59.6 W.
FALMOUTH.
Gas Out.
Gas Out.
Gas Out.
Bar. 210.8 Ft. above M.S.L.
Lat. 50°9′24″N. Long. 5.3.30 W.
STONYHURST.
R. 0·014
R. 0·683
R. 0·040
Out of Action
Bar. 360.7 Ft. above M.S.L.
Lat. 53°50′40″N. Long. 2.28.10.2 W.
KEW.
Gas Out
Gas Out.
No Trace.
Bar. 34.0 Ft. above M.S.L.
Lat. 51°28′6″N. Long. 0.18.47 W.
MLS.
VAPOUR TENSION.
INCH
INS.
RAINFALL IN INCHES MEASURED AT 10 A.M.
WIND DIRECTION
W. S. E. N.
F.
30·0
29·5
29·0
28·5
31·0
30·5

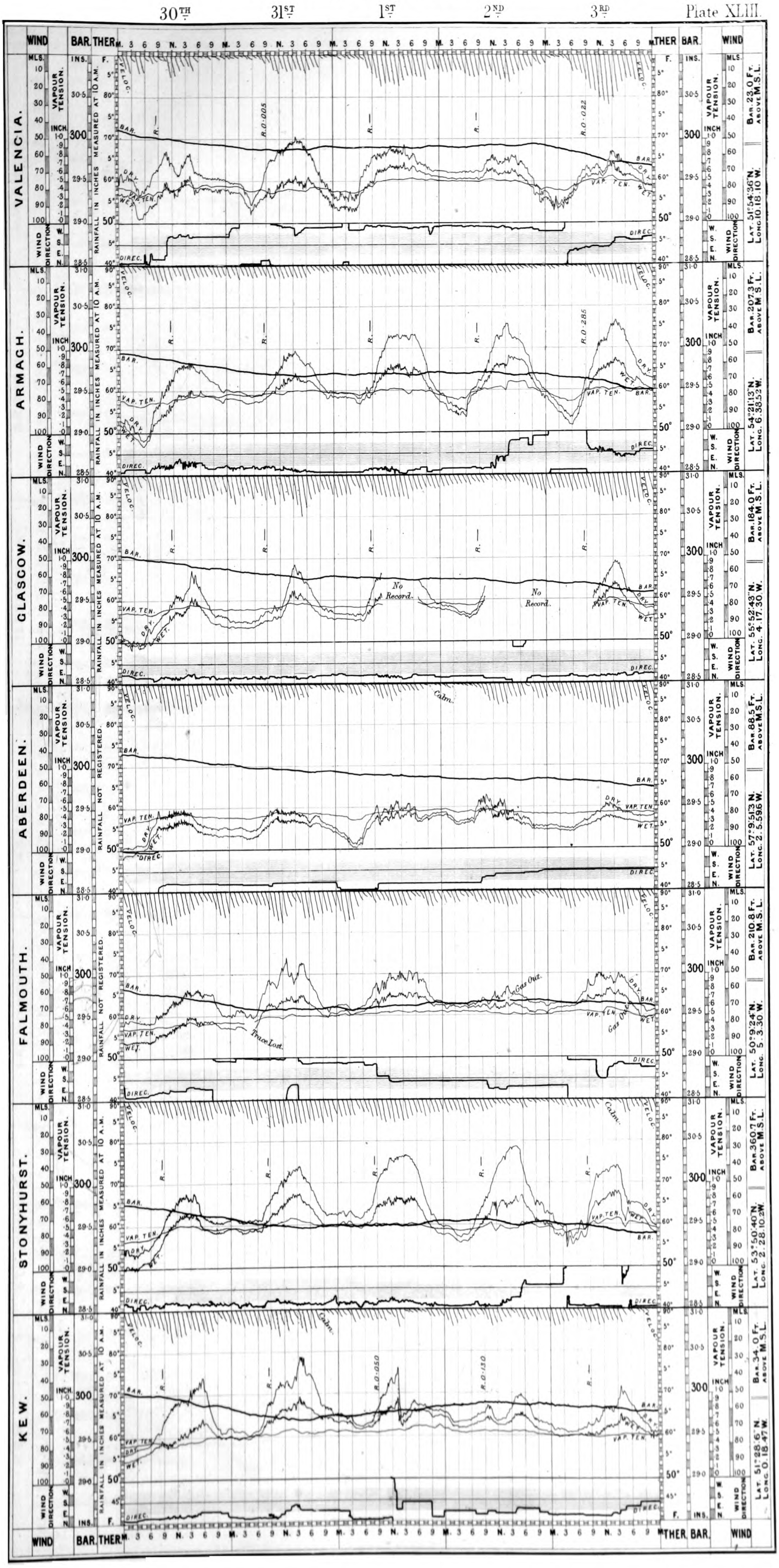
JULY, _ 1870

Plate XLII.



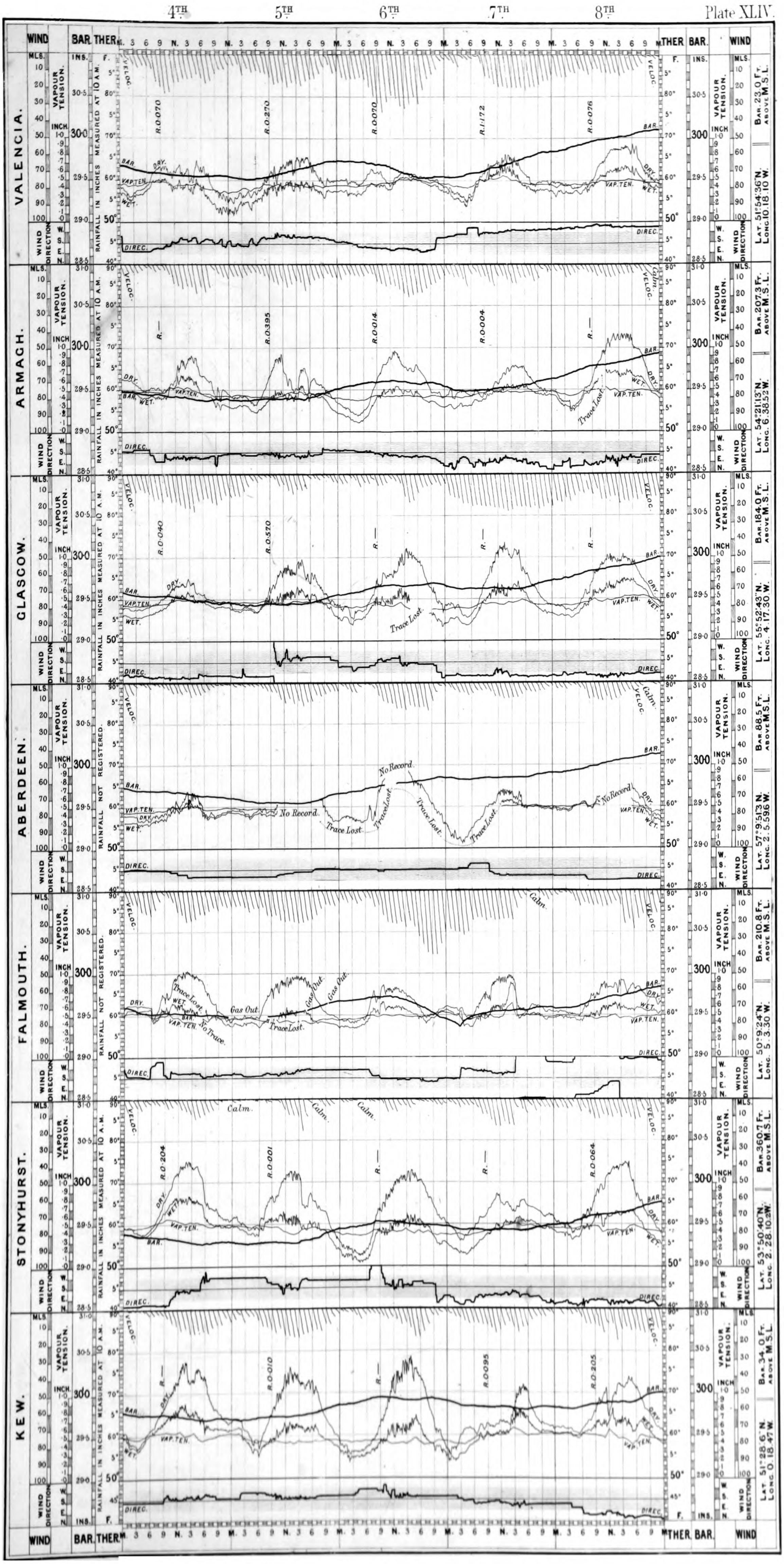
JULY & AUGUST, _1870.

Plate XLIII.



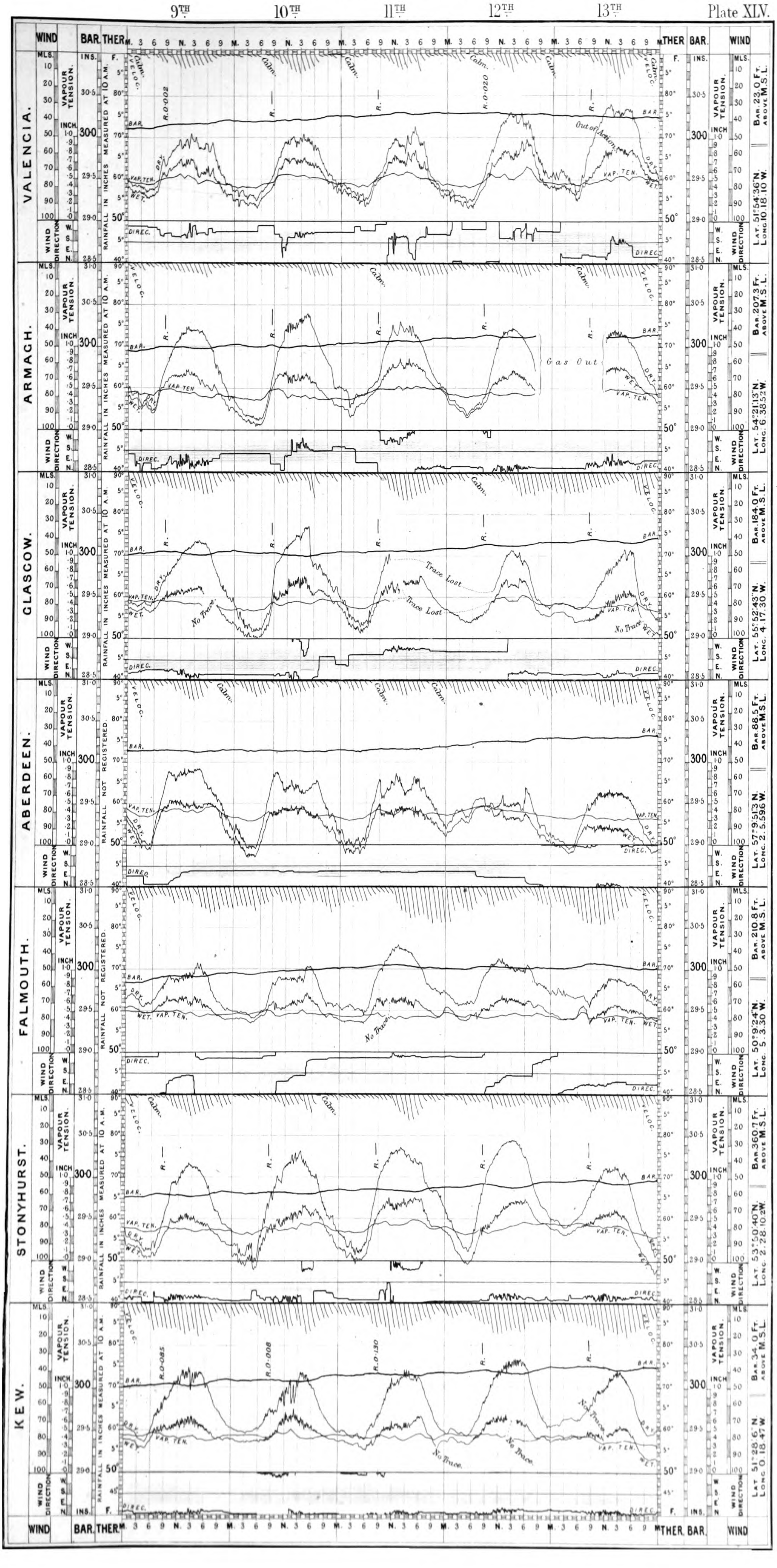
AUGUST, 1870.

Plate XLIV.



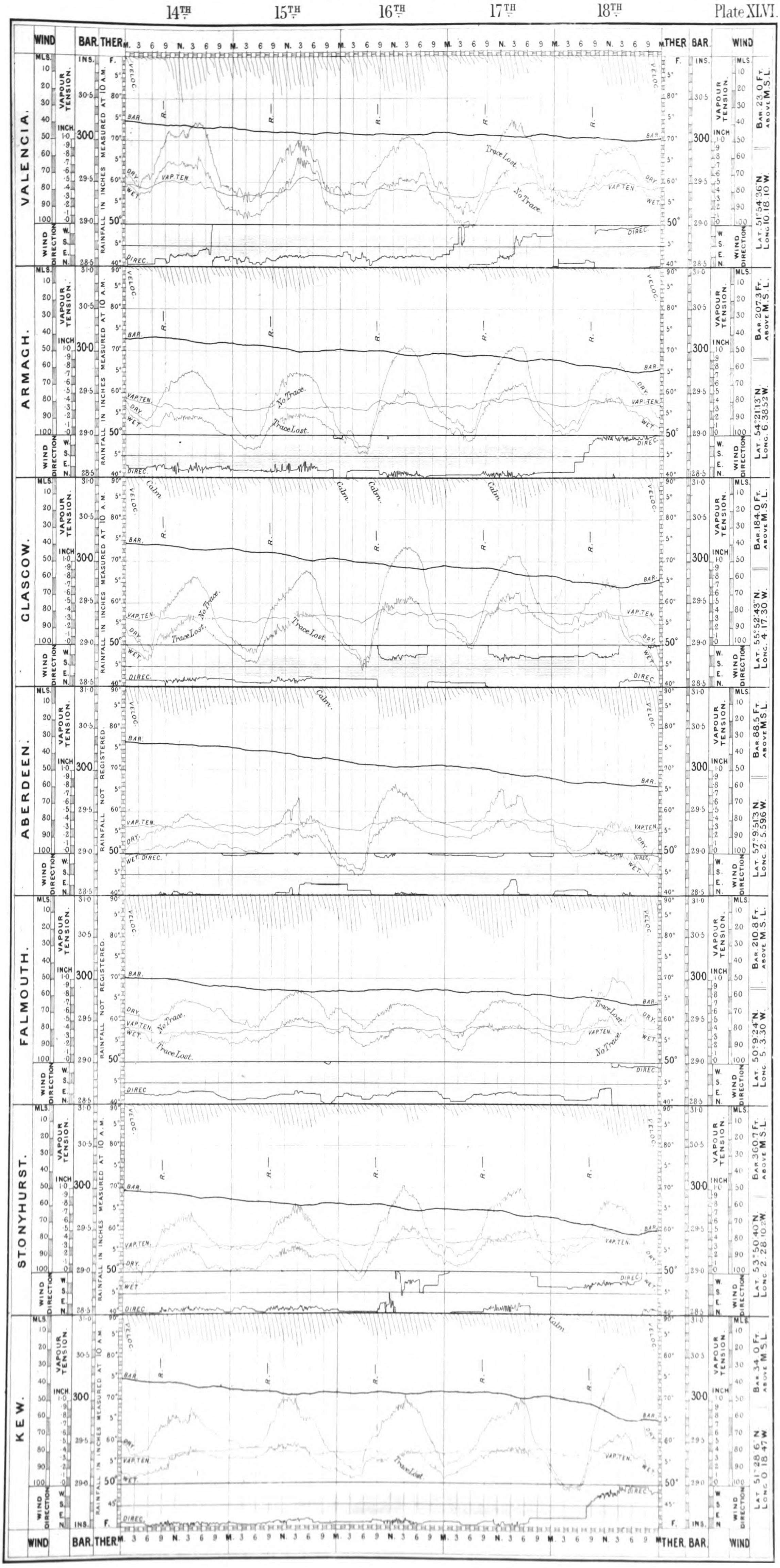
AUGUST. _ 1870.

Plate XLV.



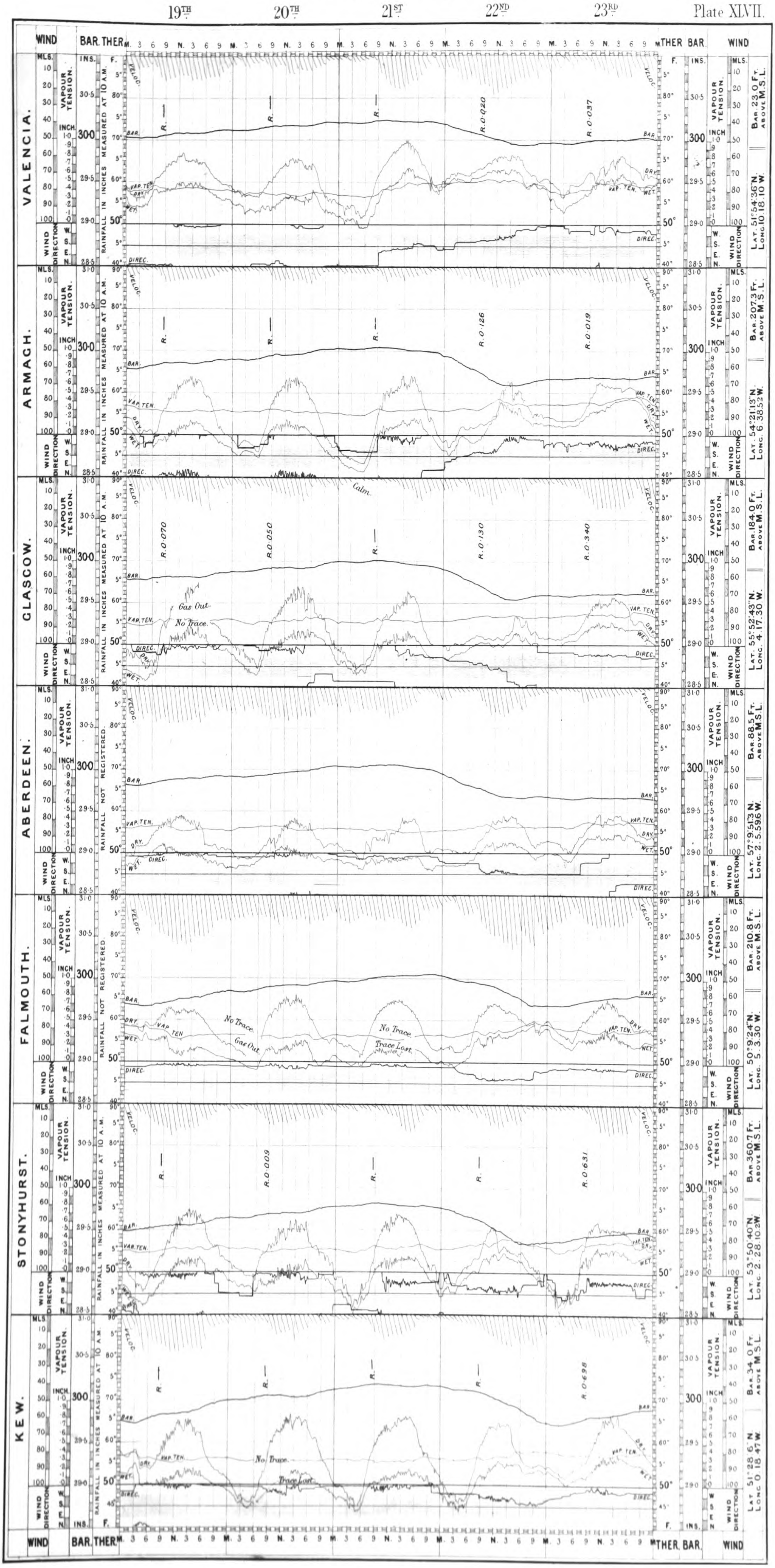
AUGUST, 1870.

Plate XLVI.



AUGUST, _ 1870.

Plate XLVII.



AUGUST, 1870.

Plate XLVIII.

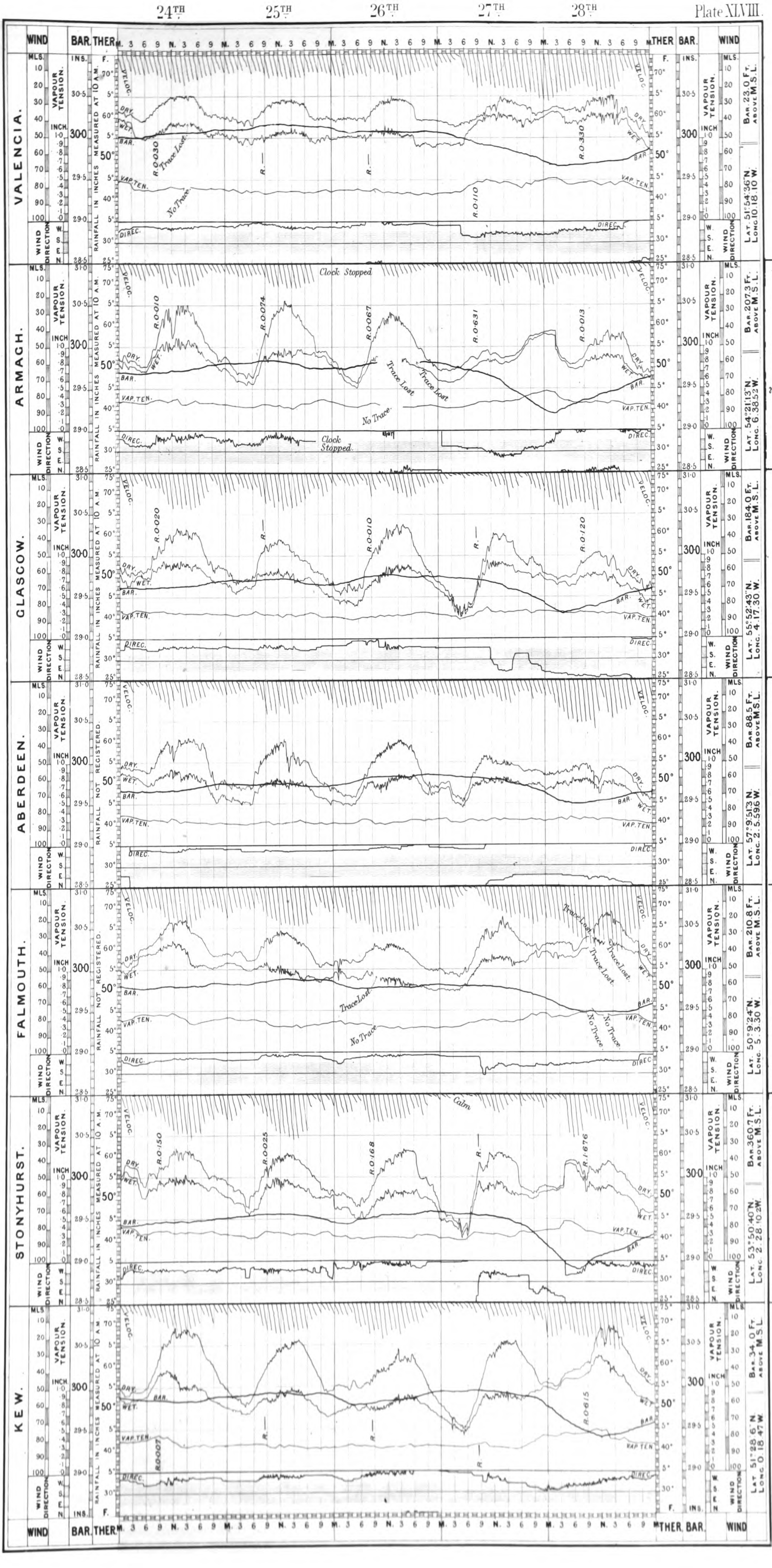


FIG. 25.

Aug. 27th 6 p.m.

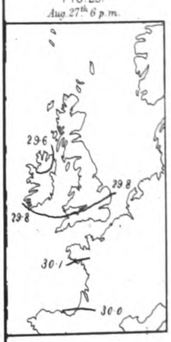

29·6
29·8
29·8
30·1
30·0

FIG. 26.

Aug. 28th 8 a.m.

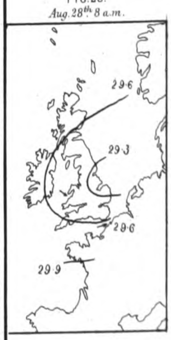
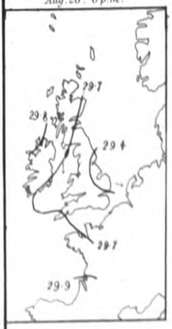

29·6
29·3
29·6
29·9

FIG. 27.

Aug. 28th 6 p.m.


29·7
29·6
29·4
29·7
29·9

AUGUST & SEPTEMBER, 1870.

Plate XLIX.

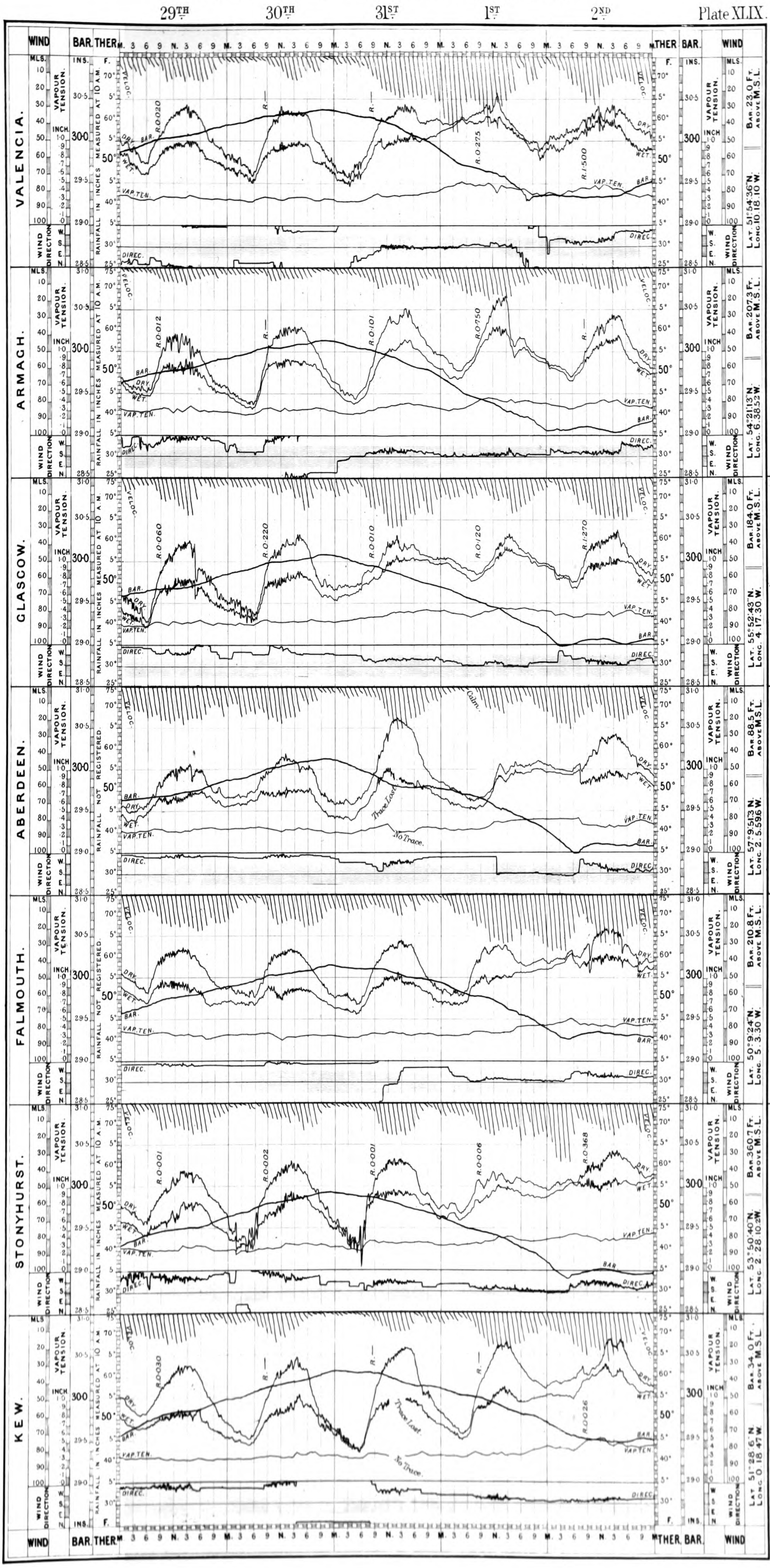


FIG. 28.

Sept. 1st 8 a.m.

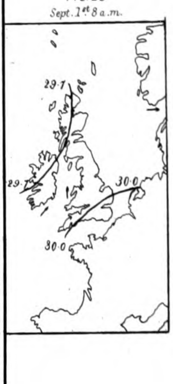
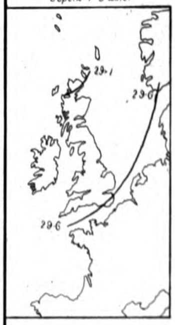

29.7
29.9
30.0
30.0

FIG. 29.

Sept. 2nd 8 a.m.



SEPTEMBER, — 1870.

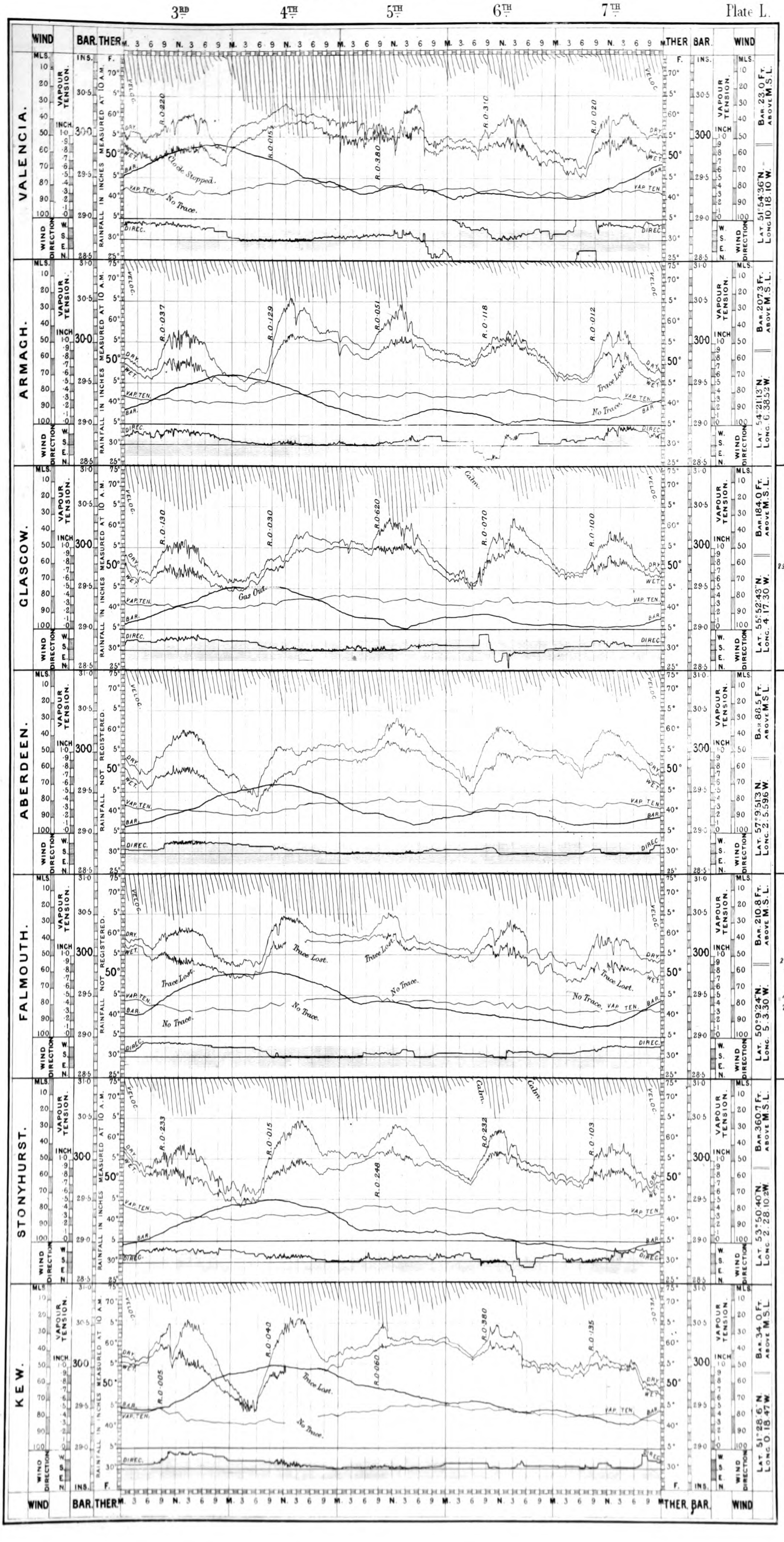


FIG. 30.
Sept 3rd 8 a.m.

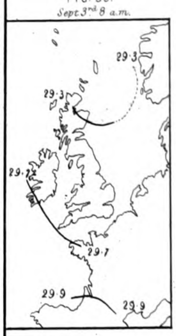
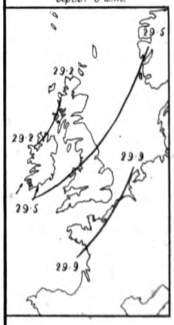

29.3
29.3
29.7
29.7
29.9
29.9

FIG. 31.
Sept 5th 8 a.m.


29.5
29.2
29.2
29.9
29.5
29.9

SEPTEMBER, 1870.

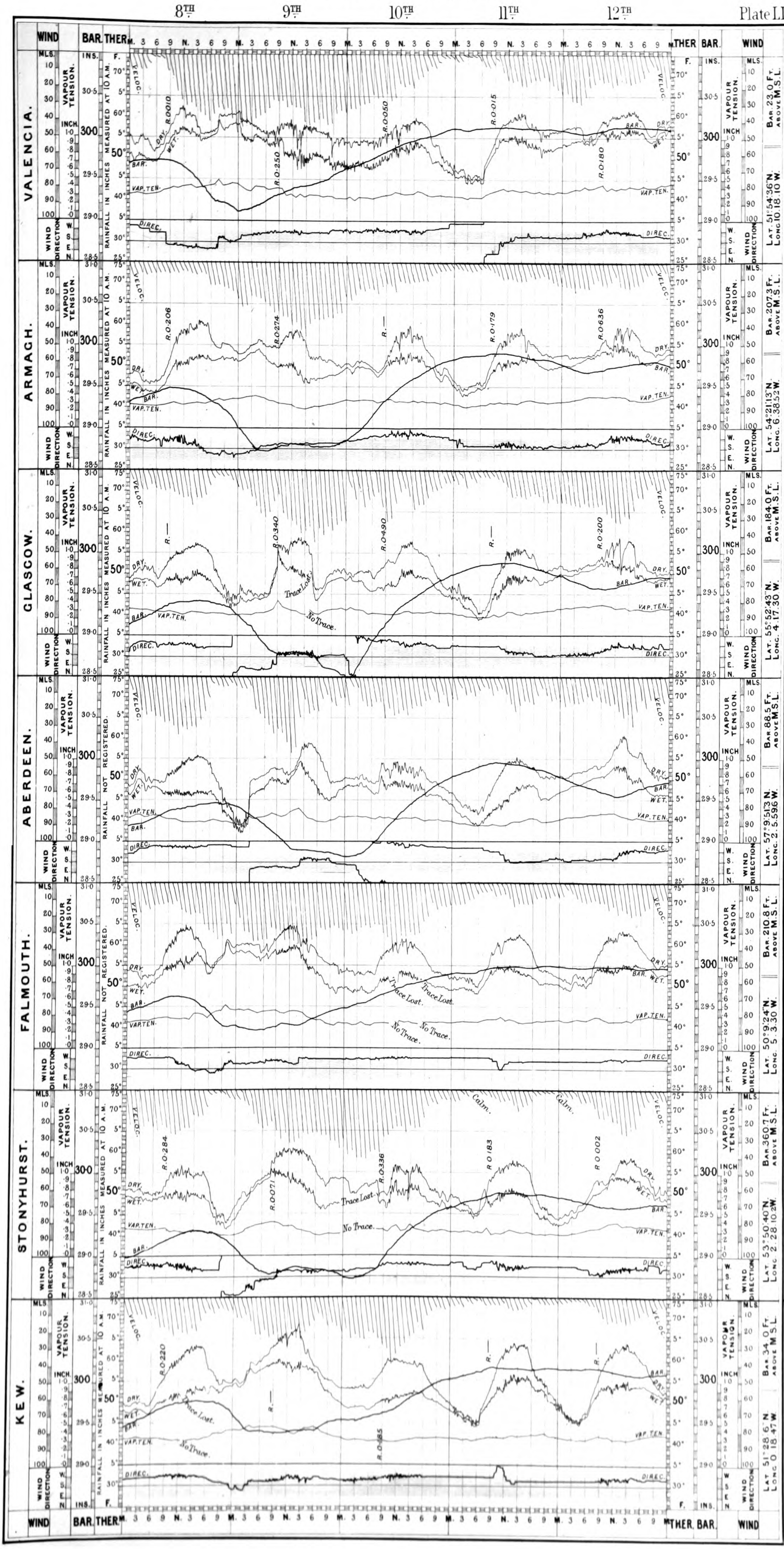


FIG. 32.
Sept. 8th 6 p.m.

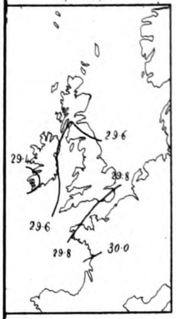

29.6
29.8
29.6
29.8
30.0

FIG. 33.
Sept. 9th 8 a.m.

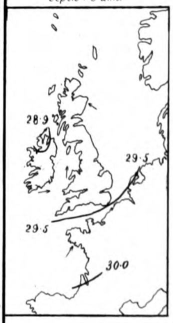
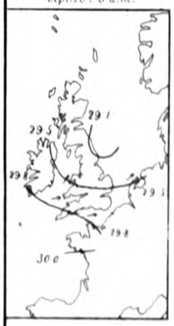
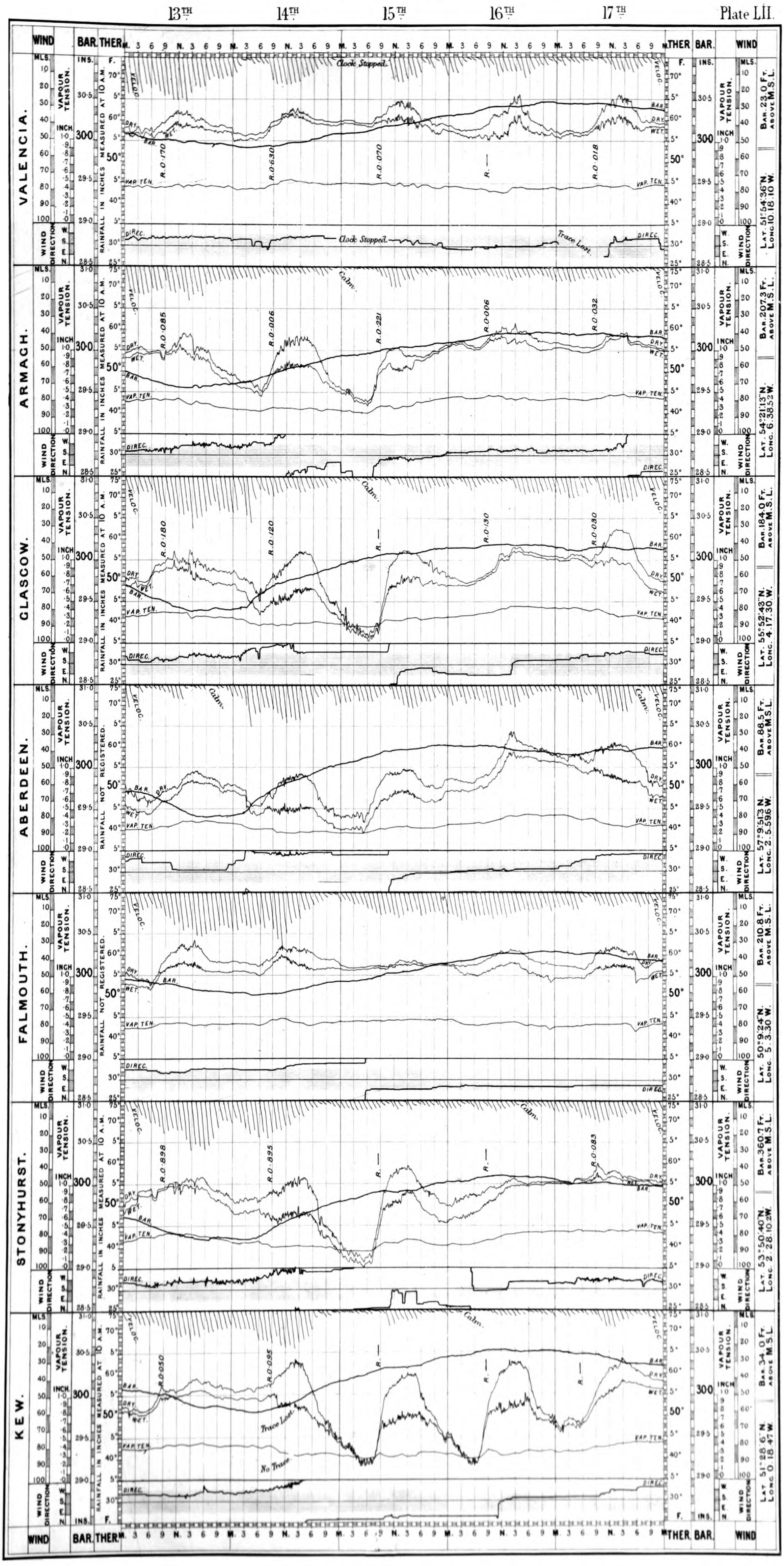

28.9
29.5
29.5
30.0

FIG. 34.
Sept. 10th 8 a.m.

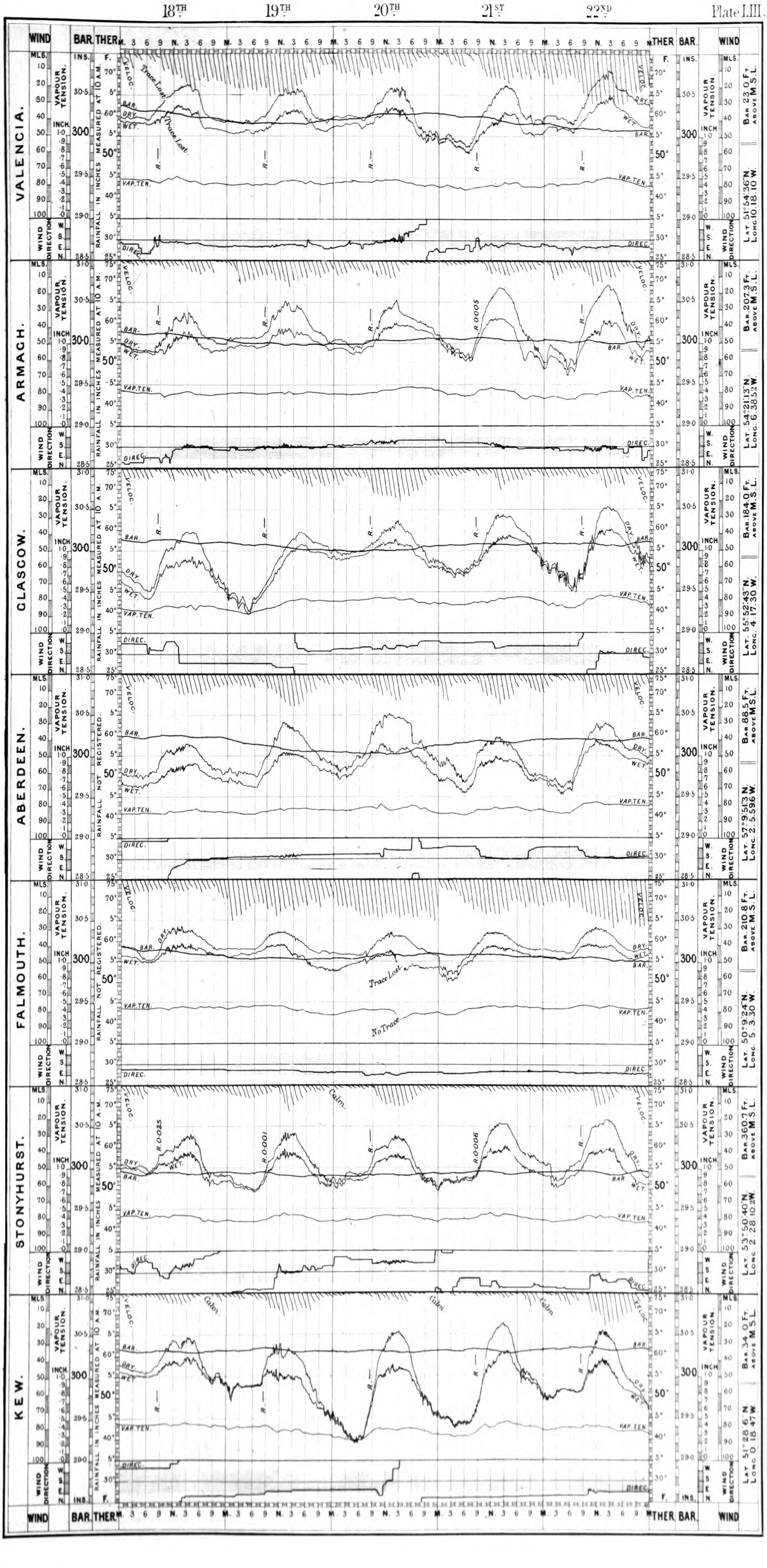

29.5
29.1
29.8
29.8
30.0

SEPTEMBER, _ 1870.



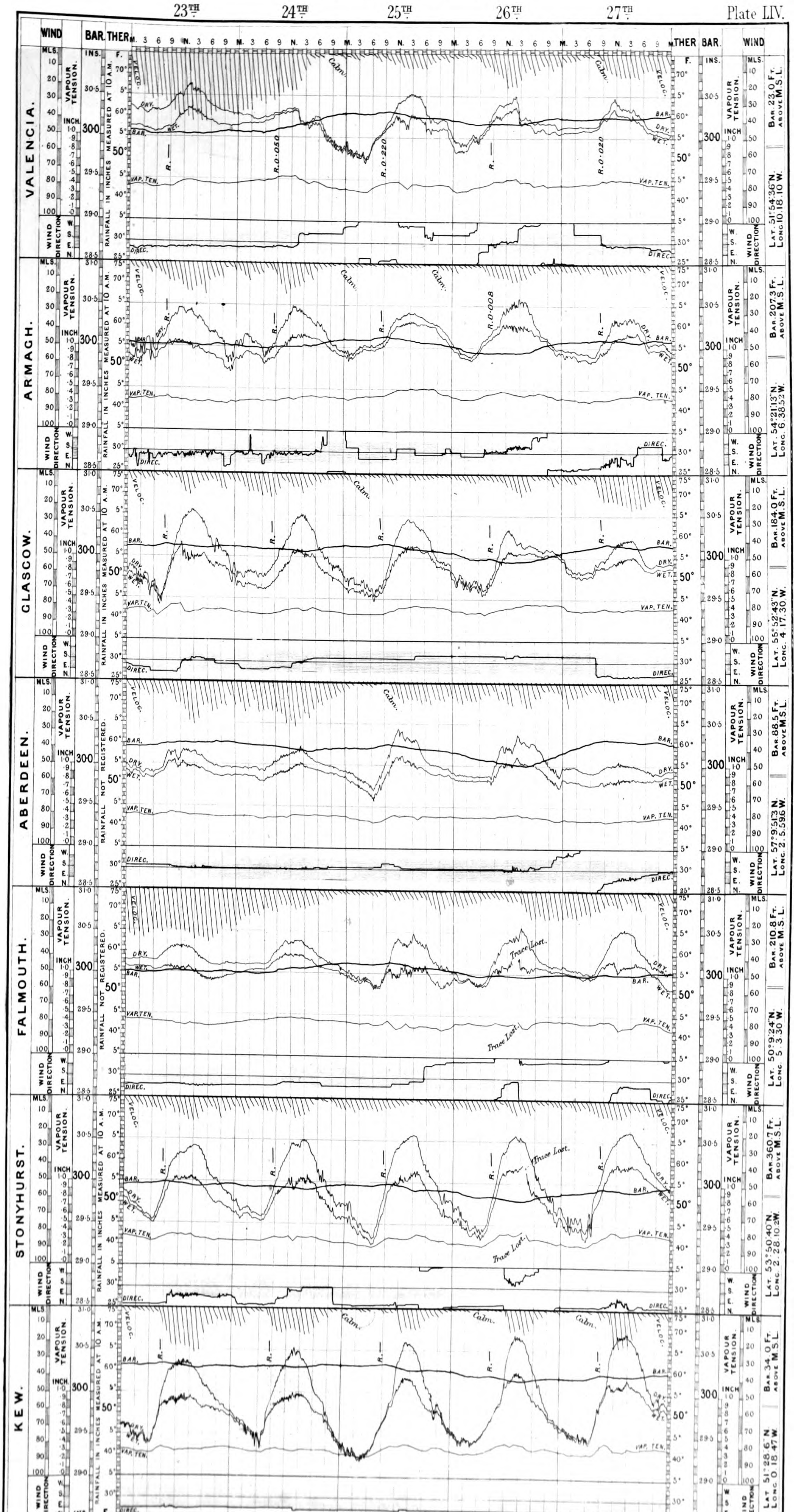
SEPTEMBER.—1870.

Plate LIII.



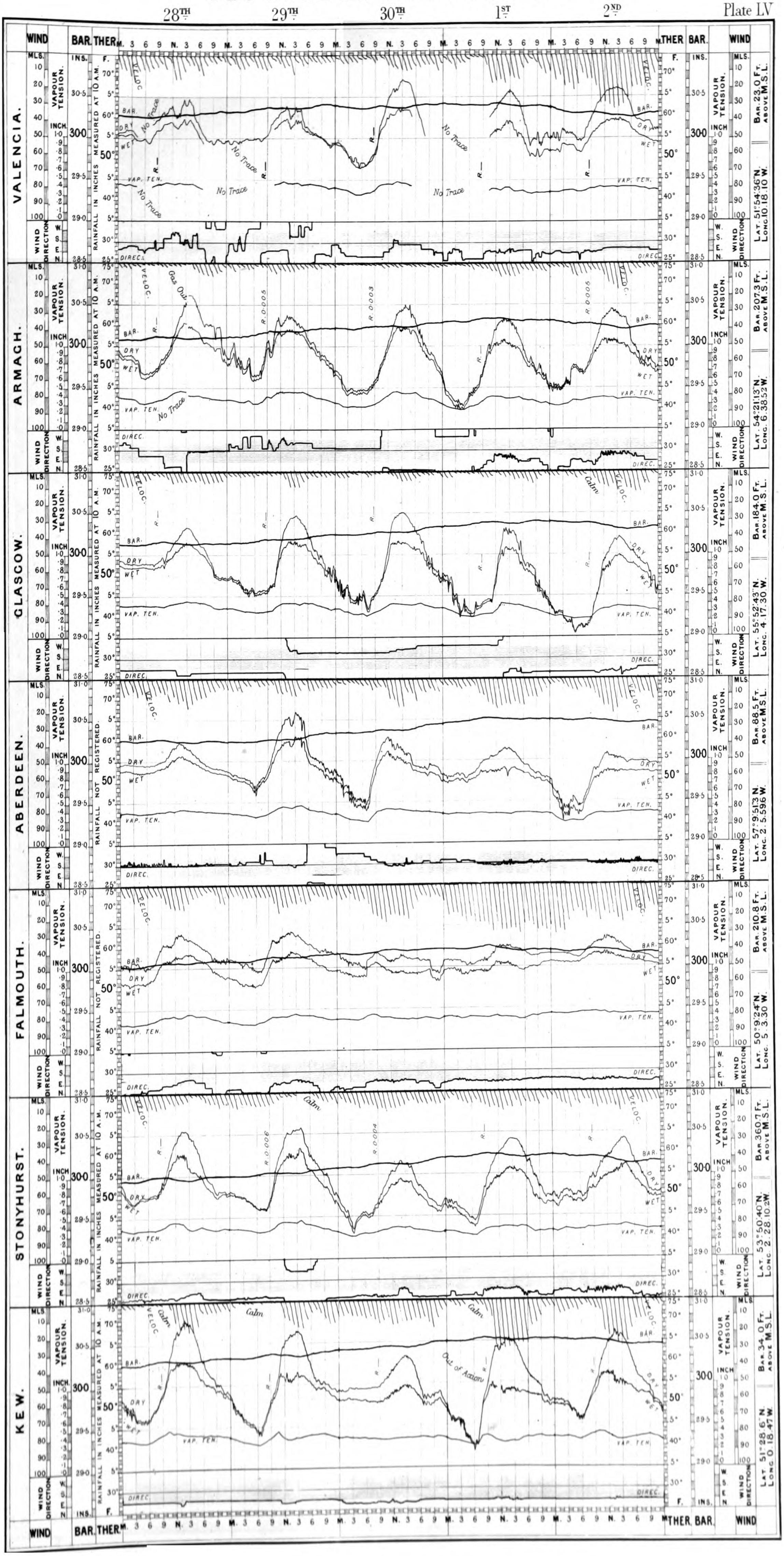
SEPTEMBER, — 1870.

Plate LIV.

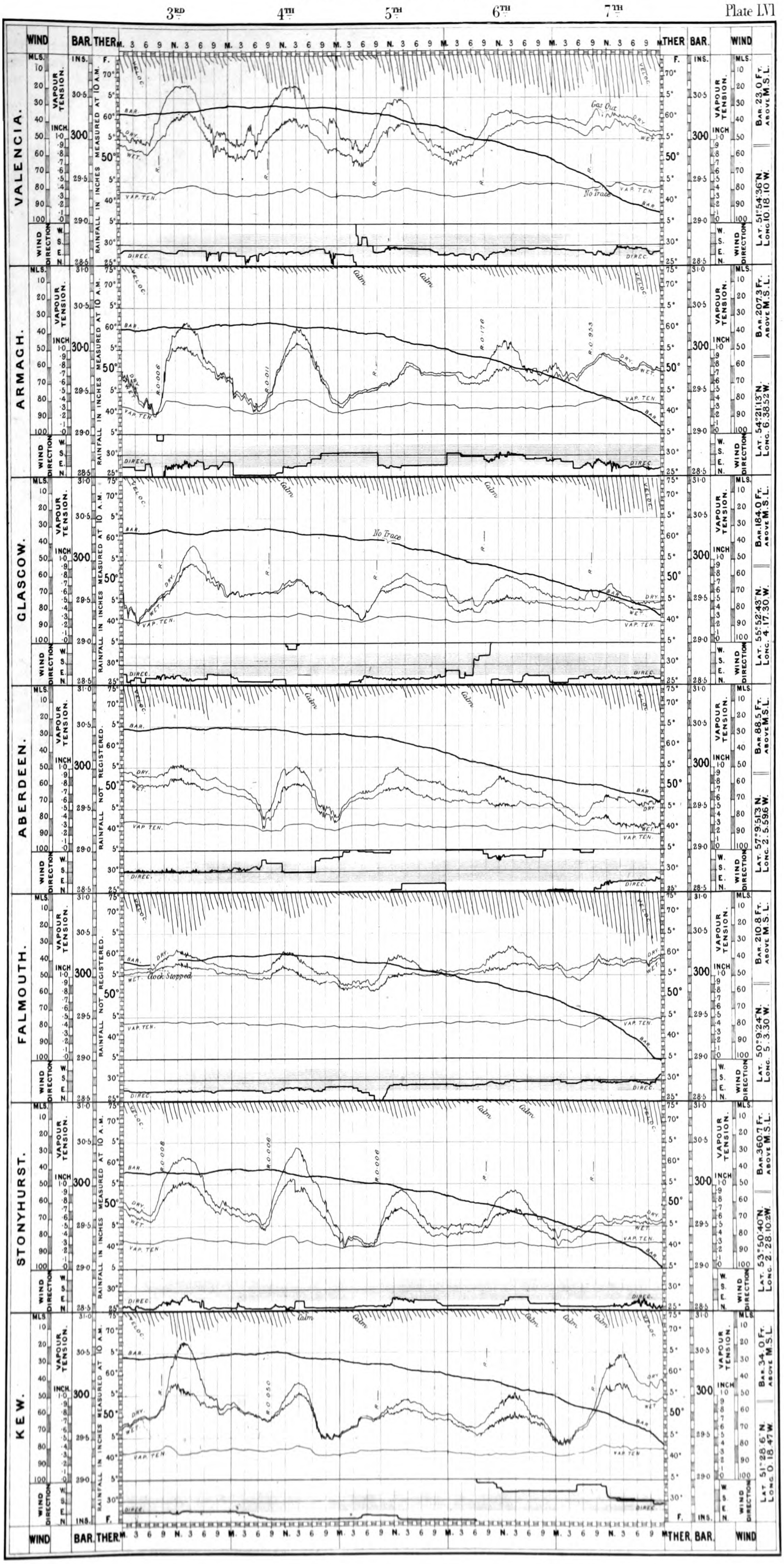


SEPTEMBER–OCTOBER 1870

Plate LV

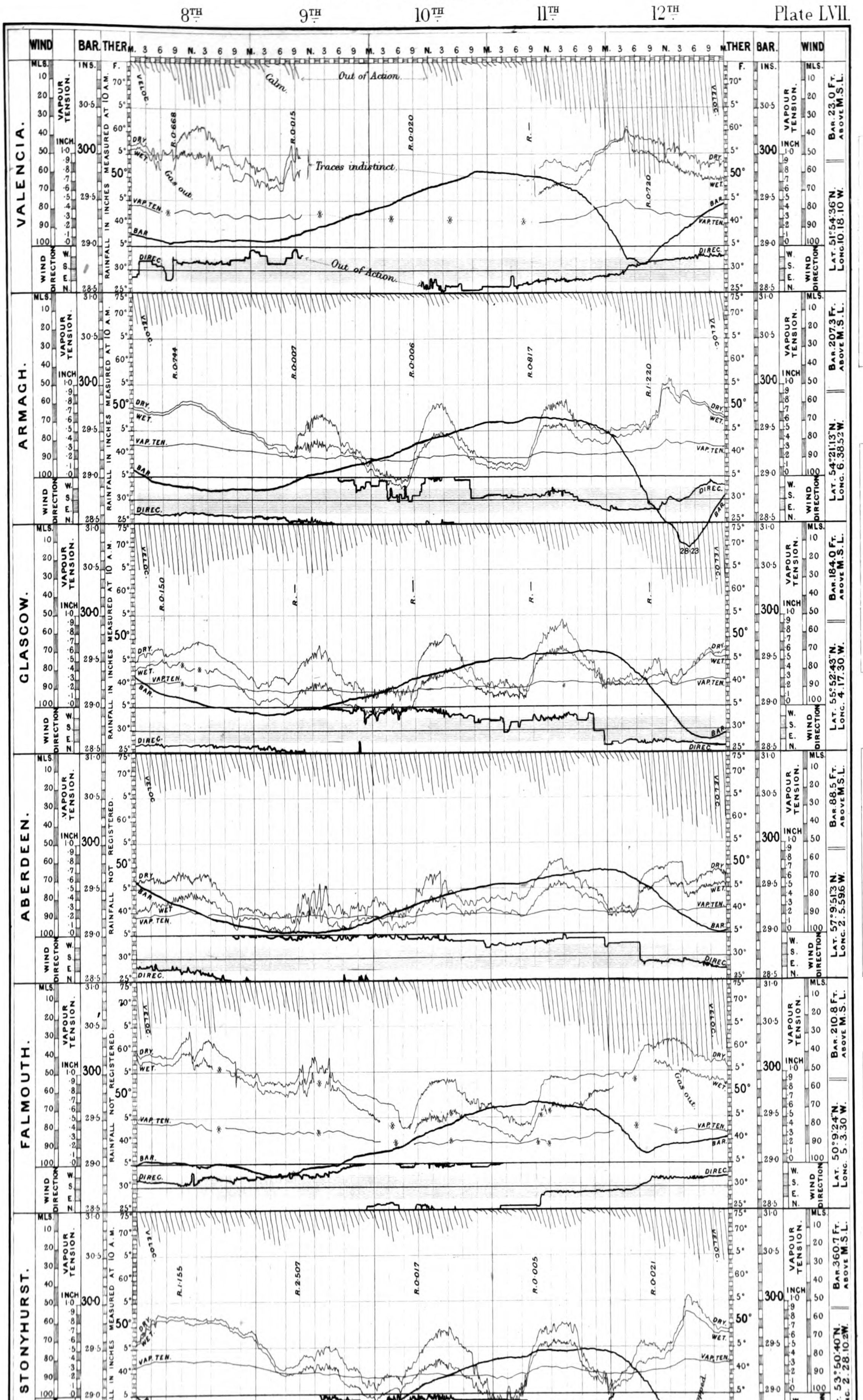


OCTOBER—1870.



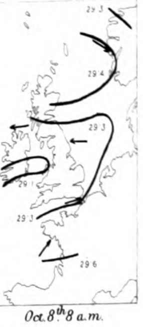
OCTOBER, _ 1870.

Plate LVII.



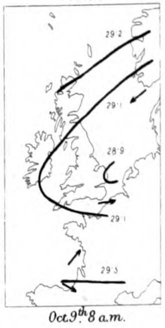
* No Trace or out of Action.

FIG. 35.


29.3
29.4
29.3
29.3
29.6

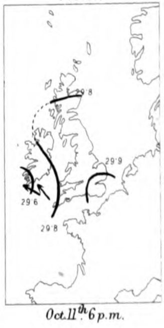
Oct. 8th 8 a.m.

FIG. 36.


29.2
29.1
28.9
29.1
29.3

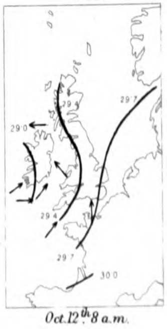
Oct. 9th 8 a.m.

FIG. 37.


29.8
29.9
29.6
29.8

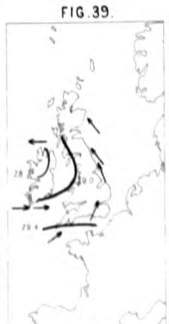
Oct. 11th 6 p.m.

FIG. 38.


29.0
29.7
29.4
29.7
30.0

Oct. 12th 8 a.m.

FIG. 39.

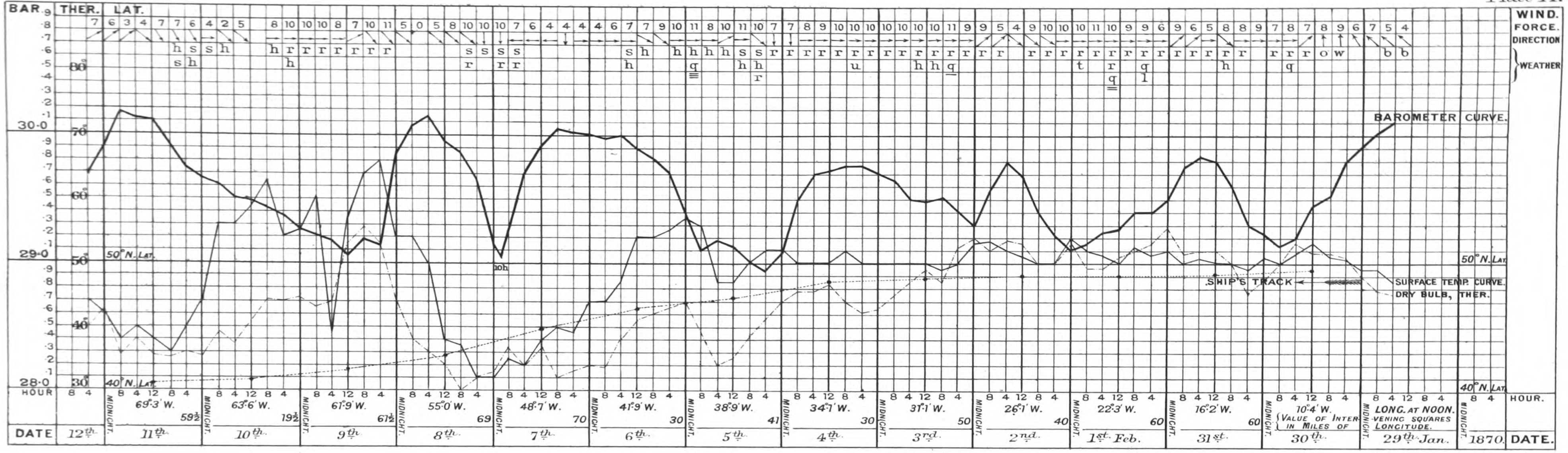


Oct. 12th 2 p.m.

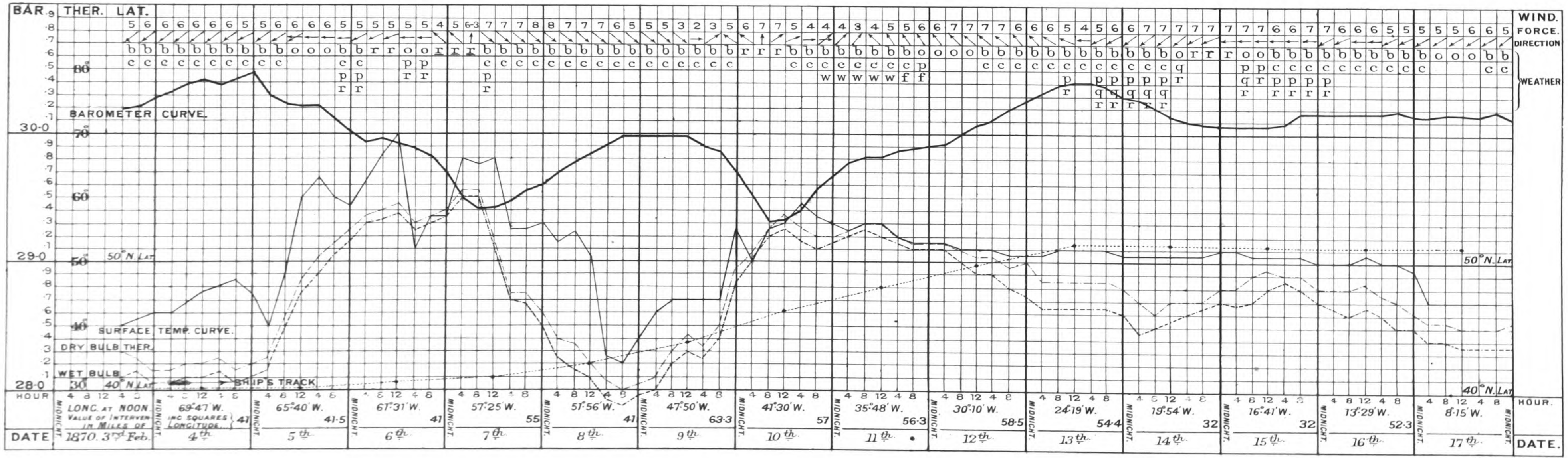
NORTH GERMAN LLOYDS S.S. "WESTPHALIA". CAPT. TRAUTMANN, OUTWARD-BOUND TO NEW YORK.

To face p. 16.

Plate A.



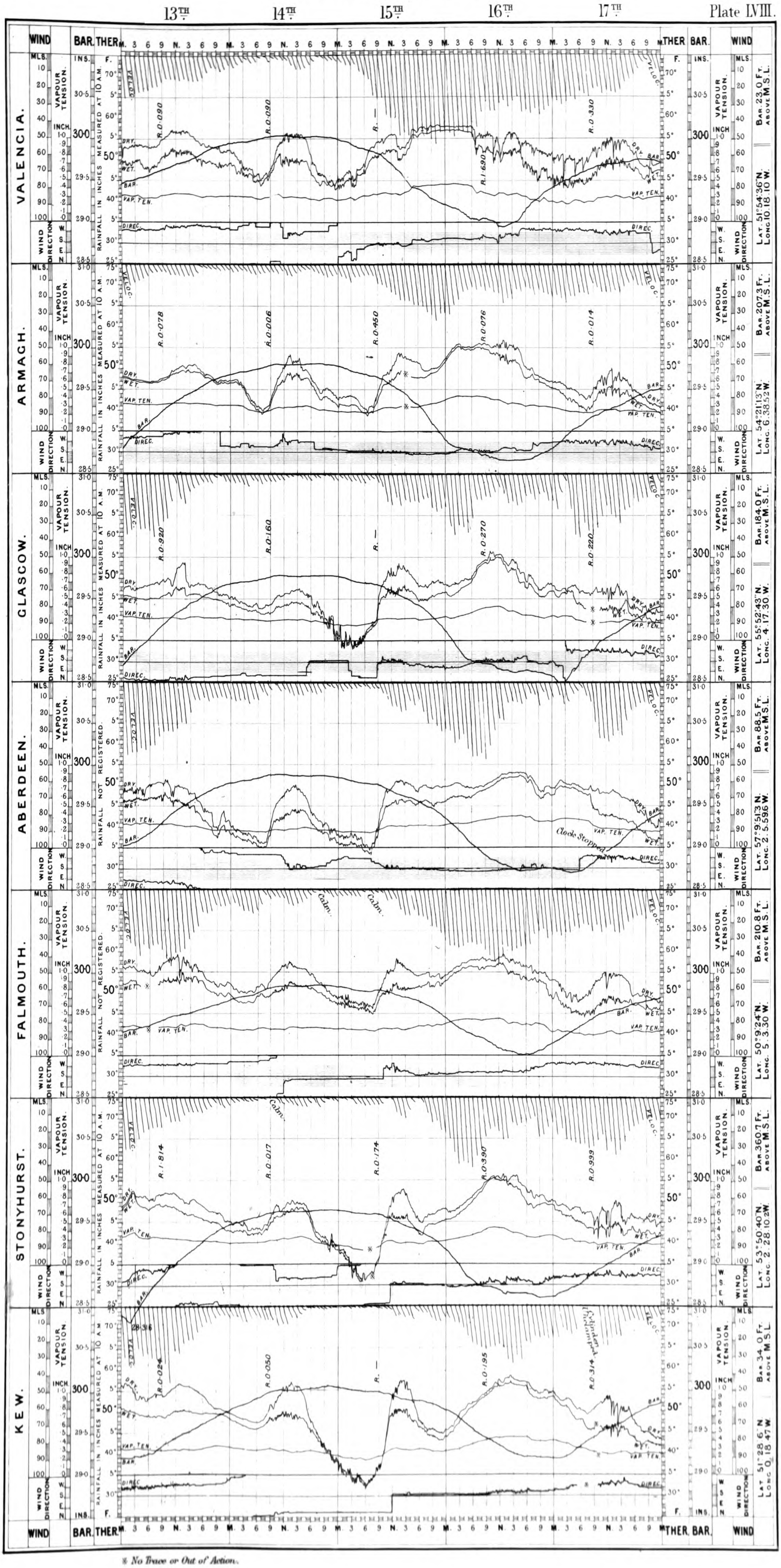
R.M.S. "PALMYRA". CAPT. W. WATSON, HOMEWARD-BOUND TO LIVERPOOL.



Malby & Sons, Lith.

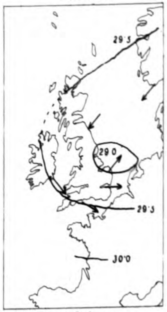
OCTOBER, — 1870.

Plate LVIII.



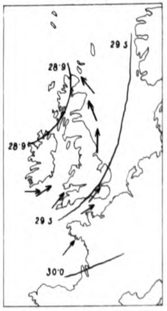
* No Trace or Out of Action.

FIG. 40.


29·5
29·0
29·3
30·0

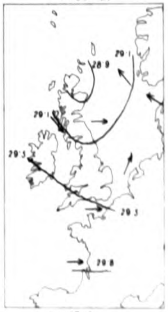
Oct. 13. 8 a.m.

FIG. 41.


29·5
28·9
28·9
29·3
30·0

Oct. 16. 8 a.m.

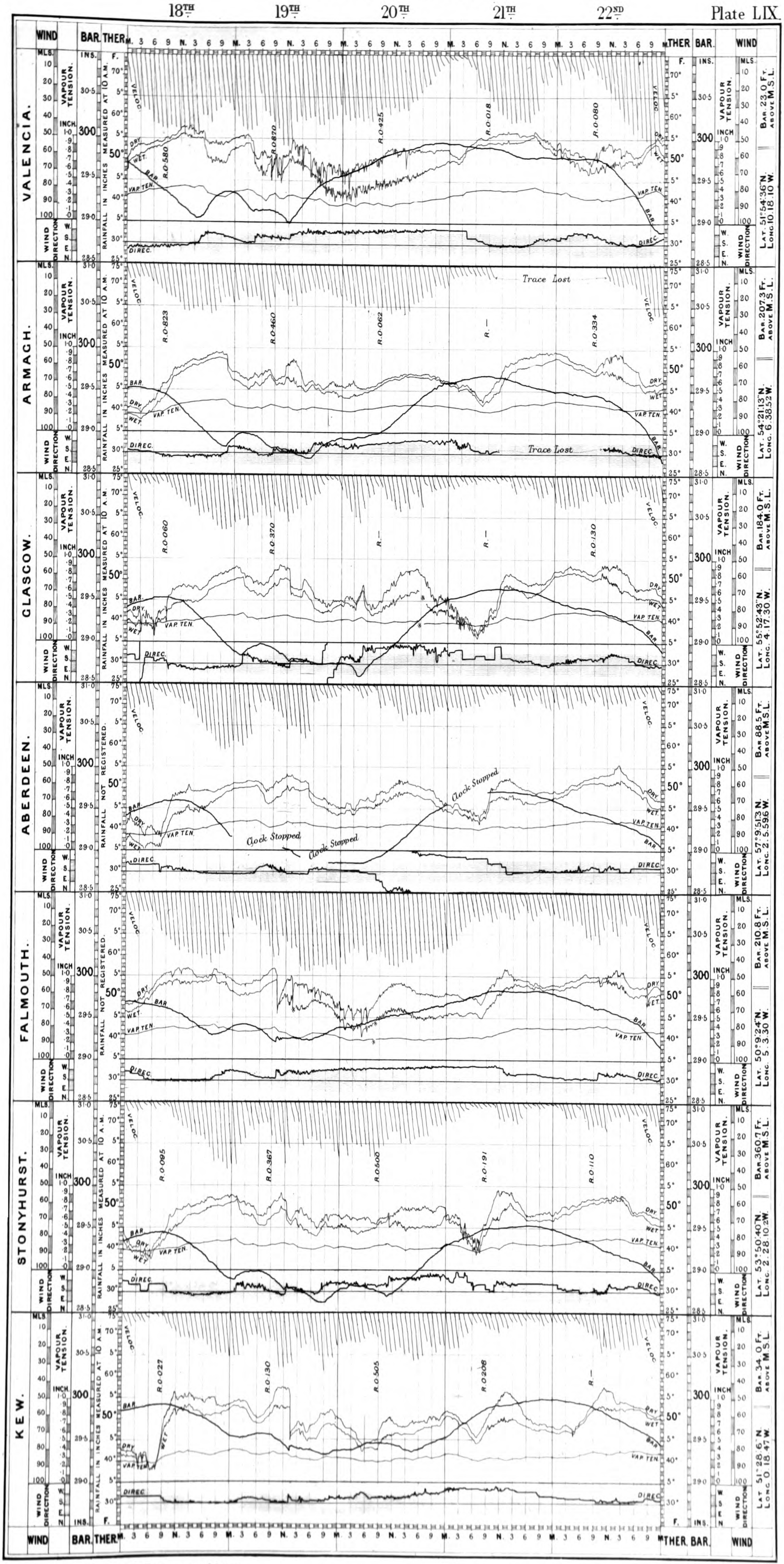
FIG. 42.


28·9
29·1
29·1
29·3
29·3
29·8

Oct. 17. 8 a.m.

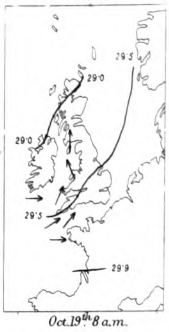
OCTOBER, 1870.

Plate LIX.



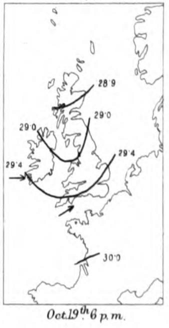
* No Trace or out of Action.

FIG. 43


29.5
29.0
29.0
29.3
29.9

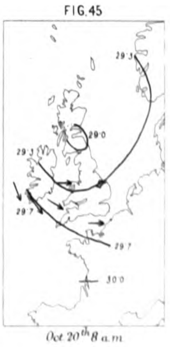
Oct. 19th 8 a.m.

FIG. 44


28.9
29.0
29.0
29.4
29.4
30.0

Oct. 19th 6 p.m.

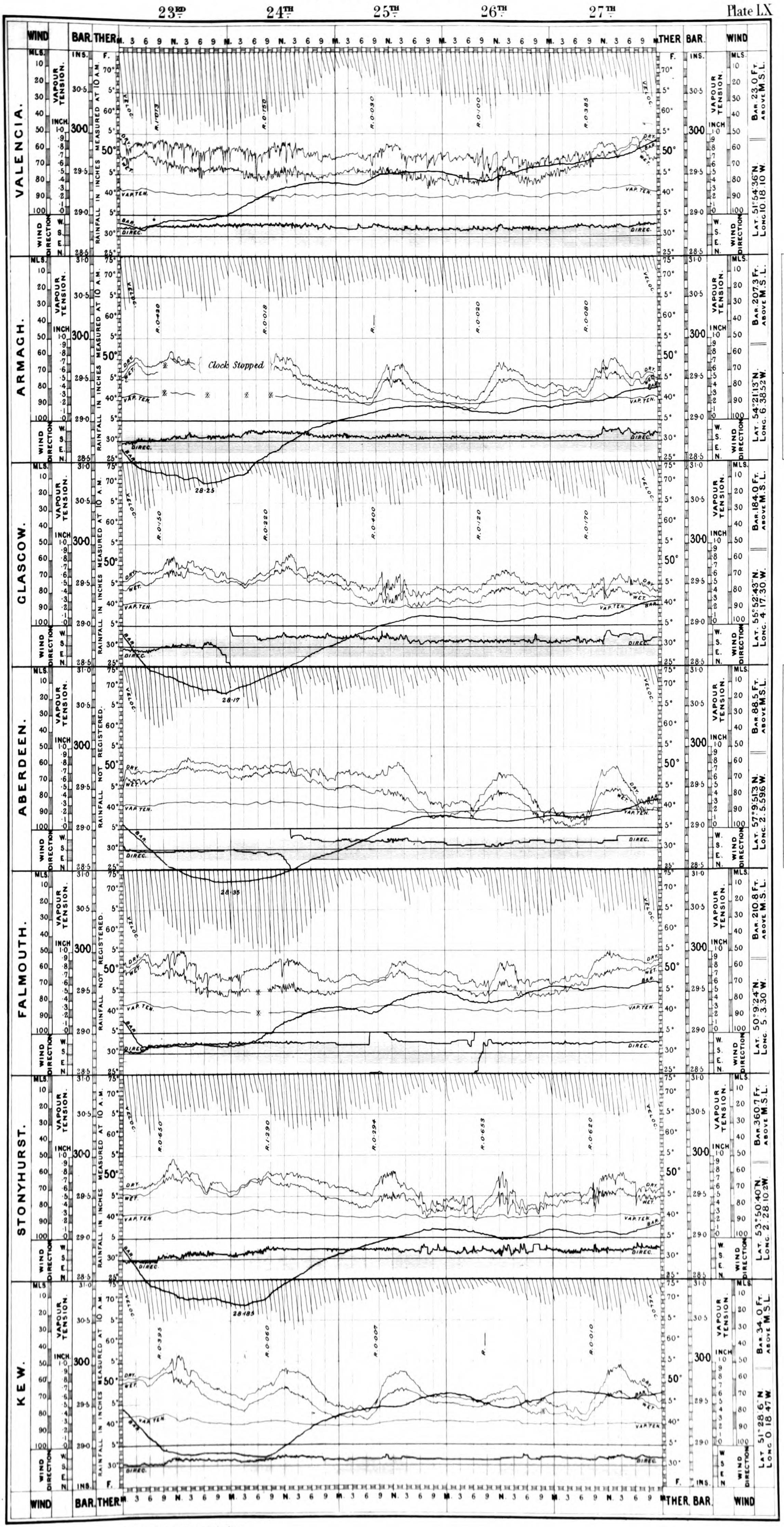
FIG. 45


29.3
29.0
29.3
29.7
29.7
30.0

Oct. 20th 8 a.m.

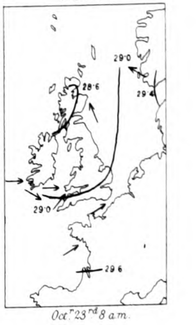
OCTOBER, — 1870.

Plate LX.



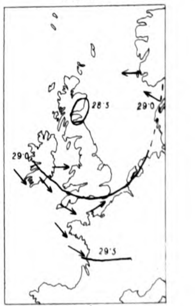
* No Trace or Out of Action

FIG. 46.


29·0
28·6
29·4
29·0
29·6

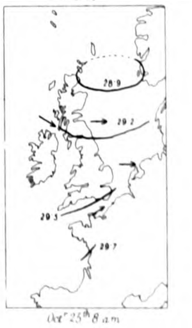
Octr 23rd 8 a.m.

FIG. 47.


28·3
29·0
29·0
29·3

Octr 24th 8 a.m.

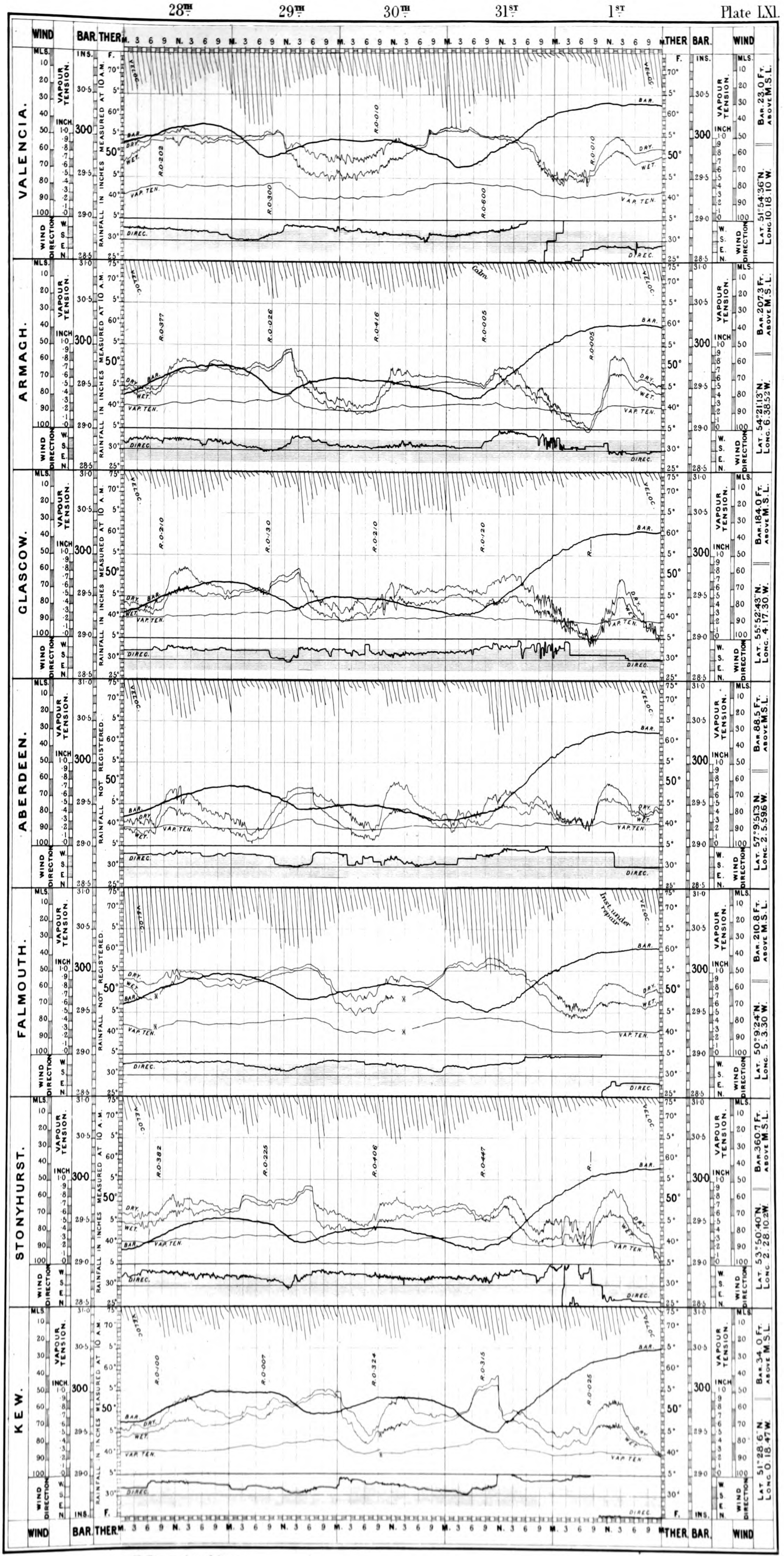
FIG. 48.


28·9
29·2
29·3
29·7

Octr 25th 8 a.m.

OCTOBER. — NOVEMBER. 1870.

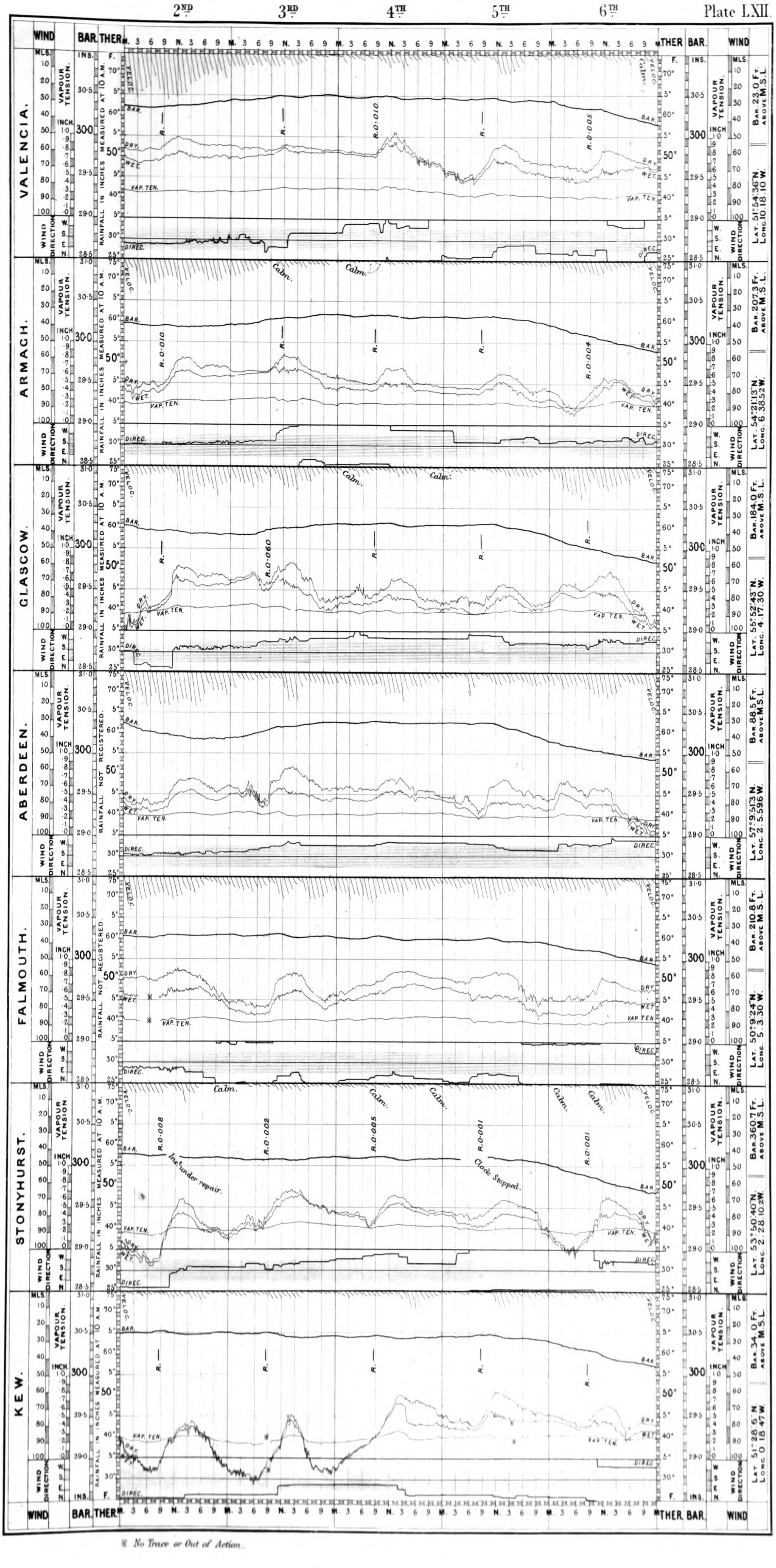
Plate LXI.



x No Trace or Out of Action.

NOVEMBER, _1870.

Plate LXII.



※ No Trace or Out of Action.

NOVEMBER. — 1870.

Plate LXIII.

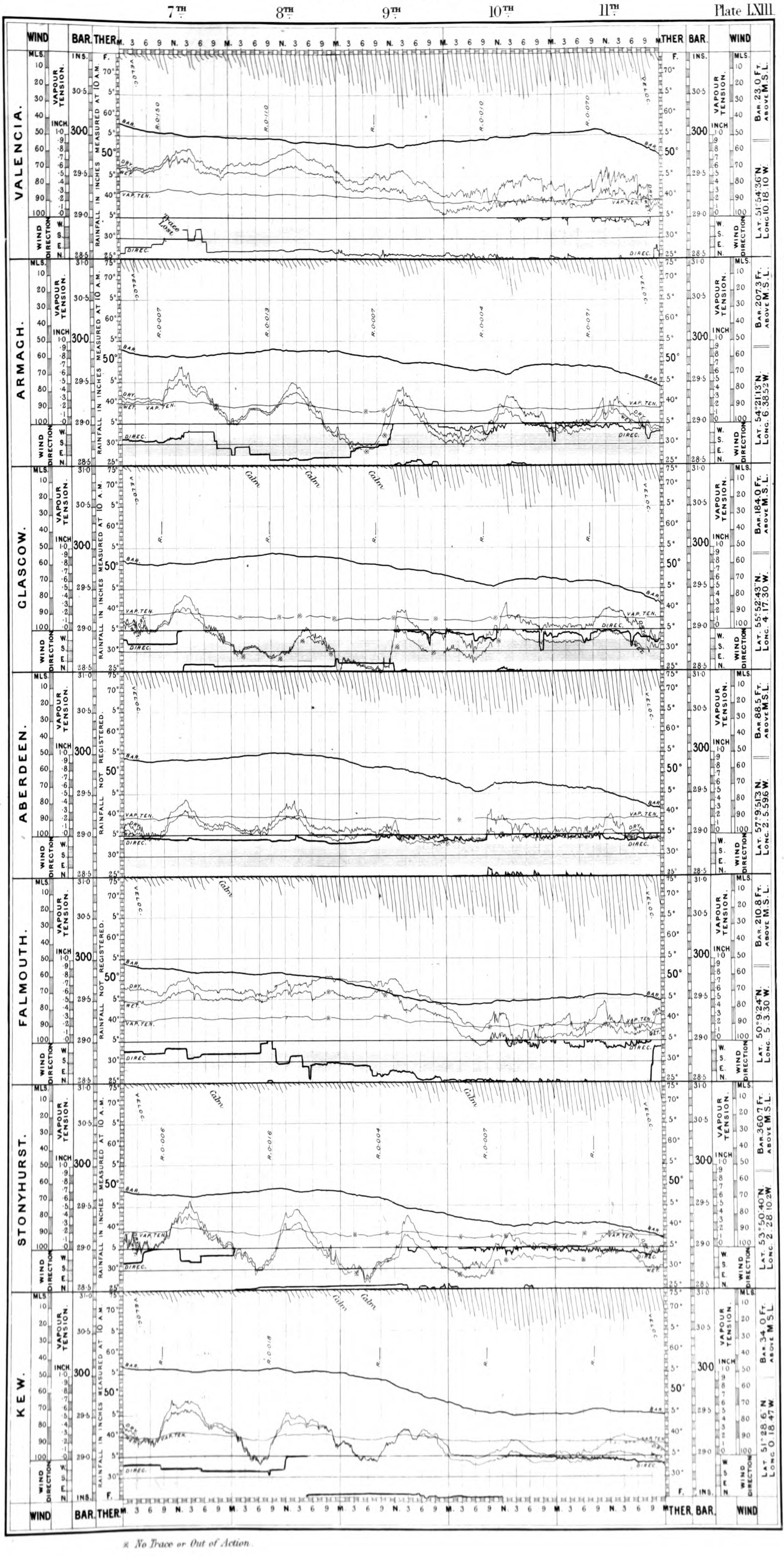
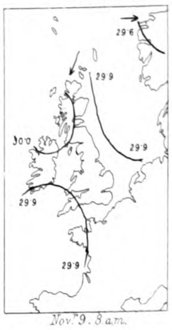
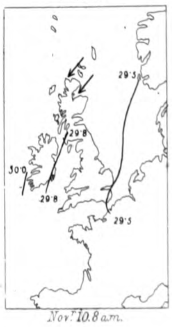


FIG. 49.


29.6
29.9
30.0
29.9
29.9
29.9

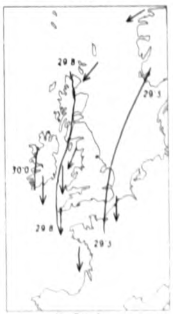
Novr 9. 8 a.m.

FIG. 50.


29.5
29.8
30.0
29.8
29.5

Novr 10. 8 a.m.

FIG. 51.


29.8
29.5
30.0
29.8
29.5

Novr 11. 8 a.m.

* No Trace or Out of Action.

NOVEMBER, _1870.

Plate LXIV.

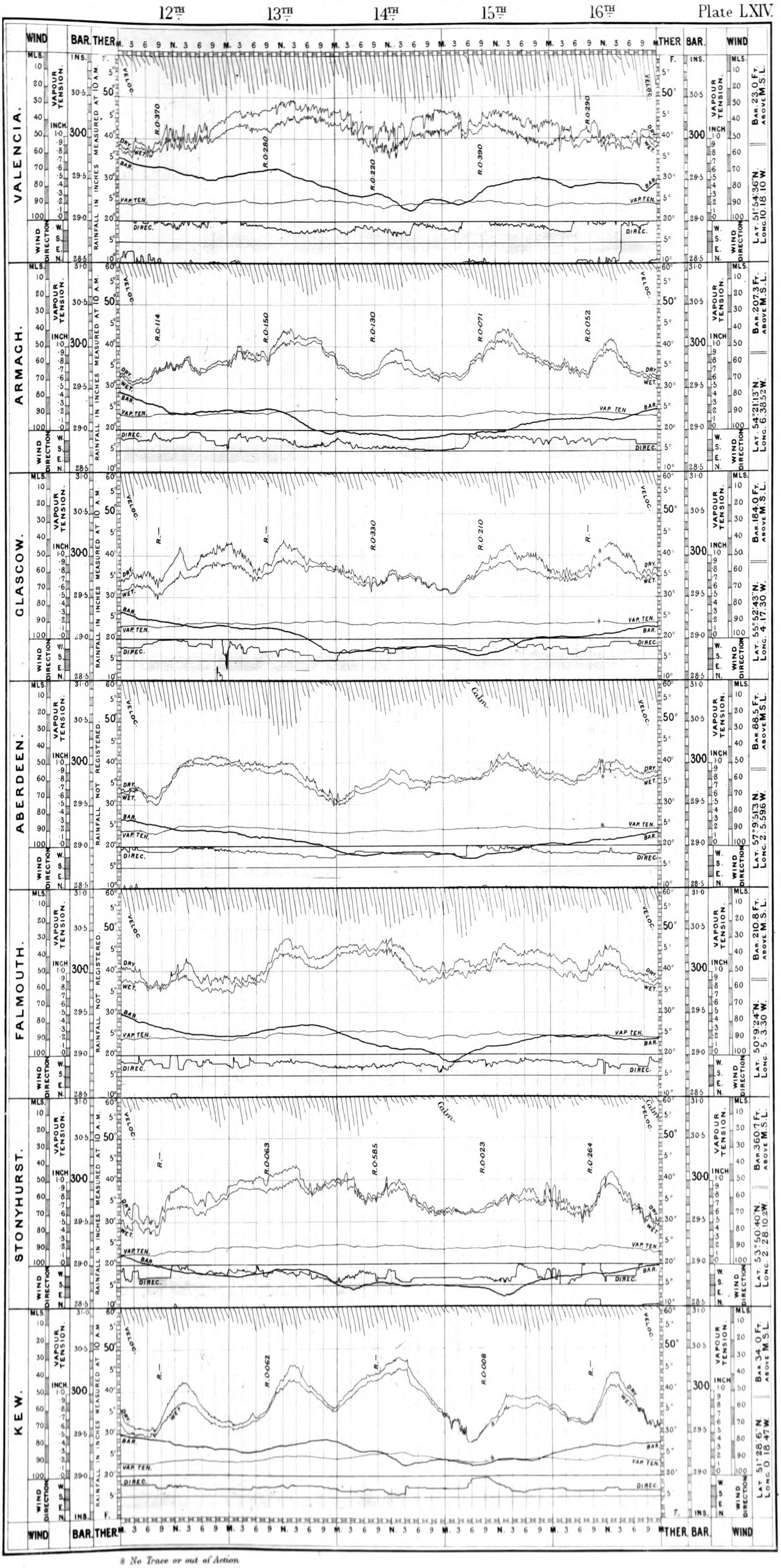
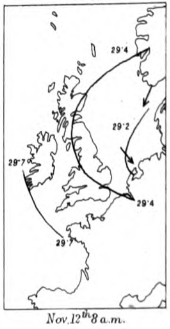


FIG. 52

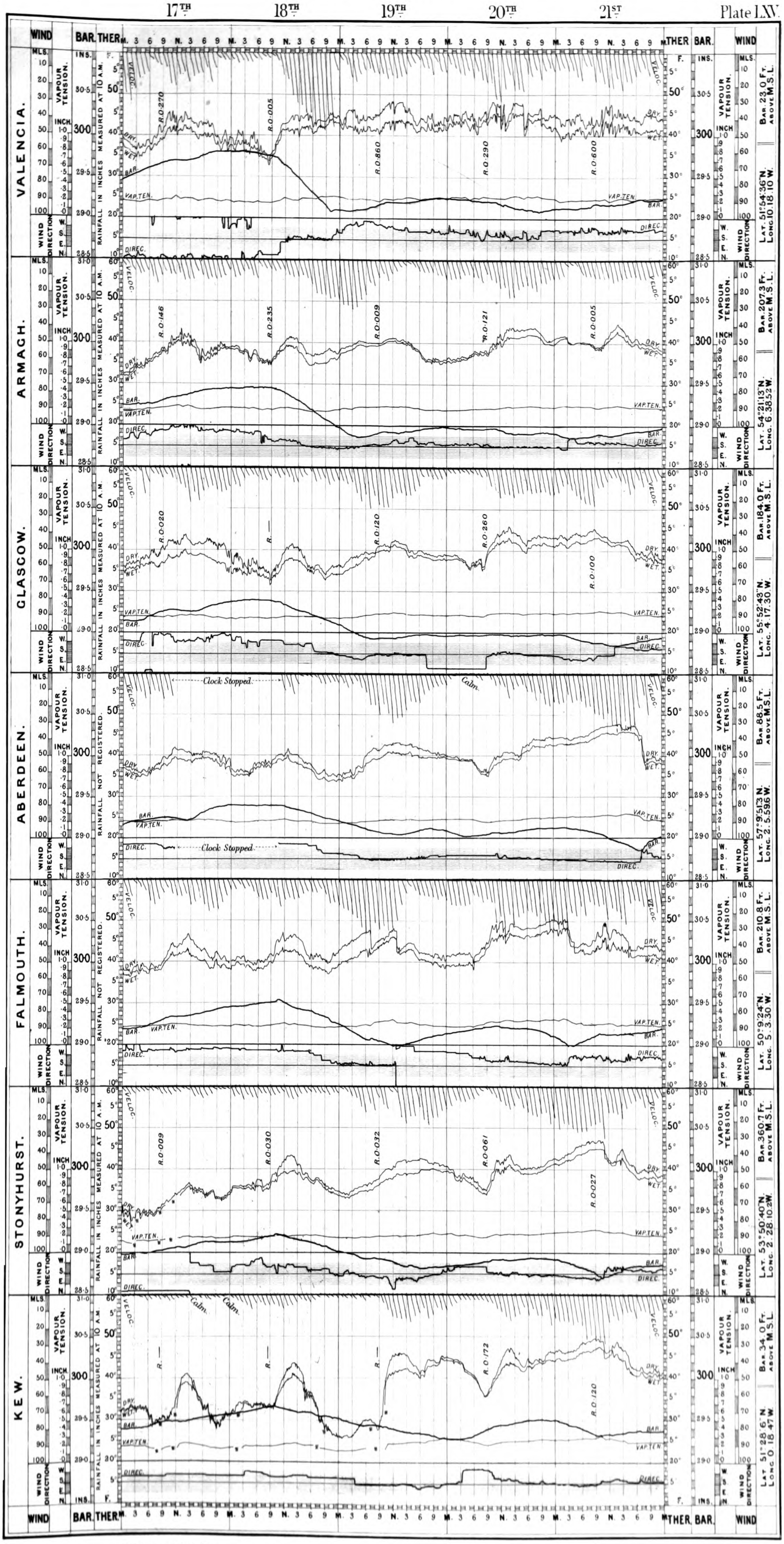

29·4
29·2
29·7
29·4
29·7

Nov. 12th 8 a.m.

* No Trace or out of Action.

NOVEMBER, 1870.

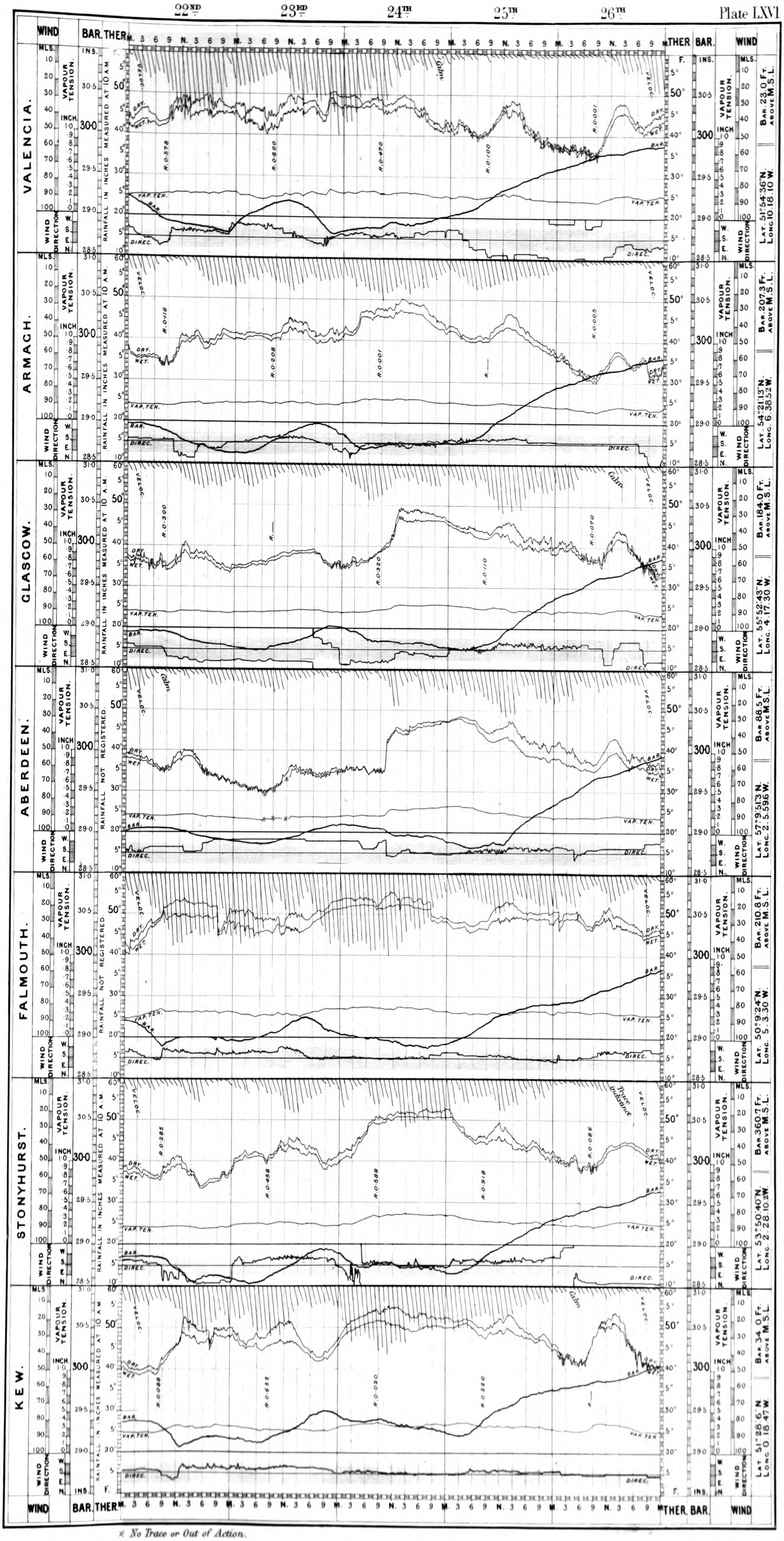
Plate LXV.



* No Trace or Out of Action.

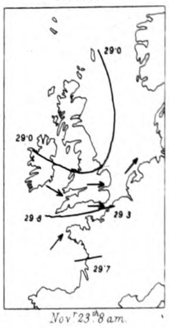
NOVEMBER, — 1870.

Plate LXVI



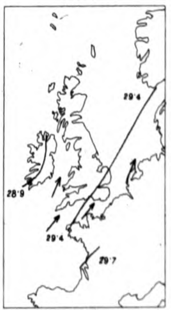
× No Trace or Out of Action.

FIG. 53


29·0
29·0
29·6
29·3
29·7

Novr 23rd 8 a.m.

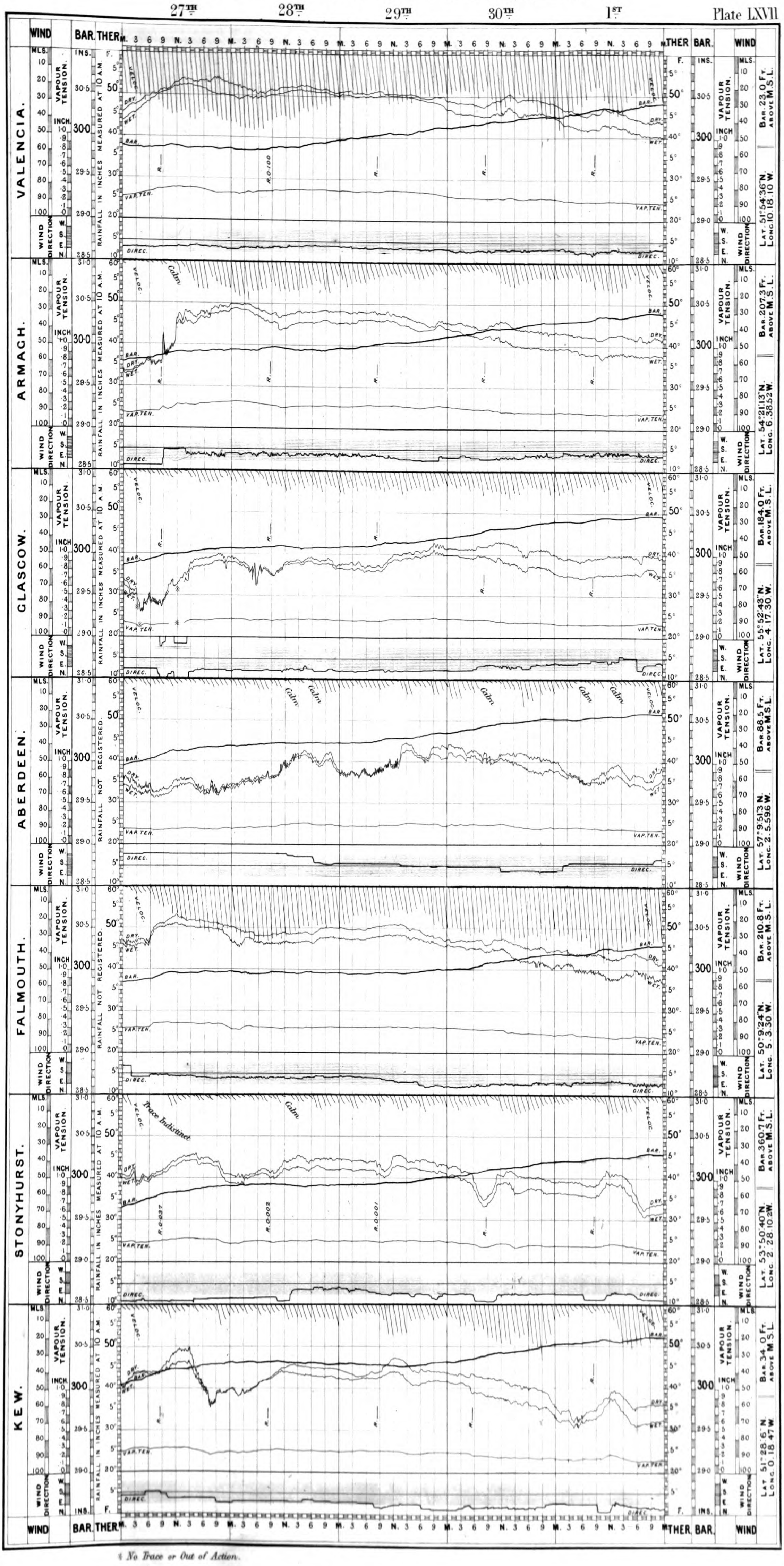
FIG. 54


29·4
28·9
29·4
29·7

Novr 24th 8 a.m.

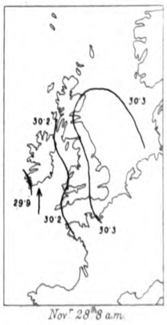
NOVEMBER, — DECEMBER, — 1870.

Plate LXVII



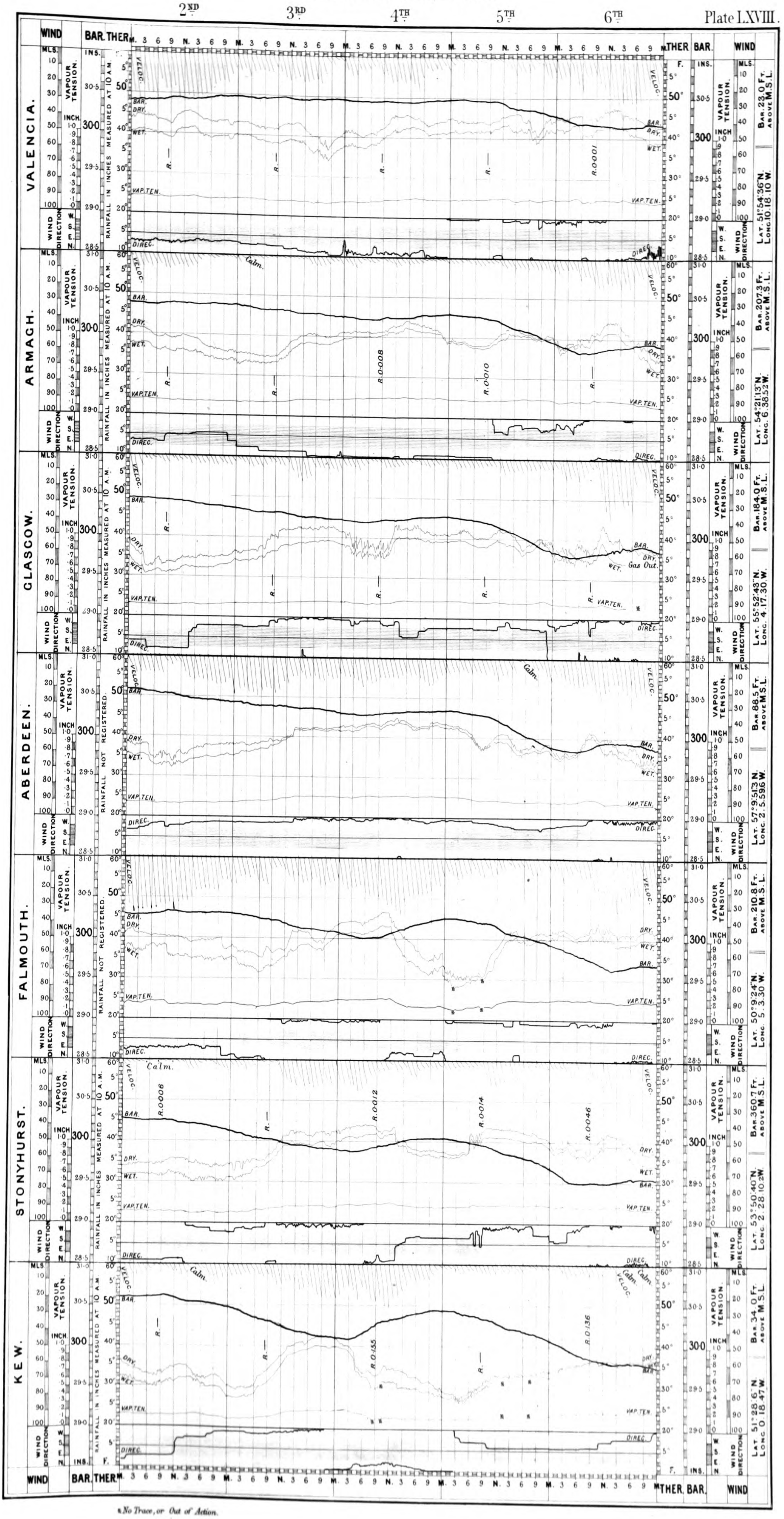
* No Trace or Out of Action.

FIG. 55.


30·3
30·2
29·9
30·2
30·3

Novr 28th 8 a.m.

DECEMBER, 1870.



* No Trace, or Out of Action.

DECEMBER, — 1870.

Plate LXIX.

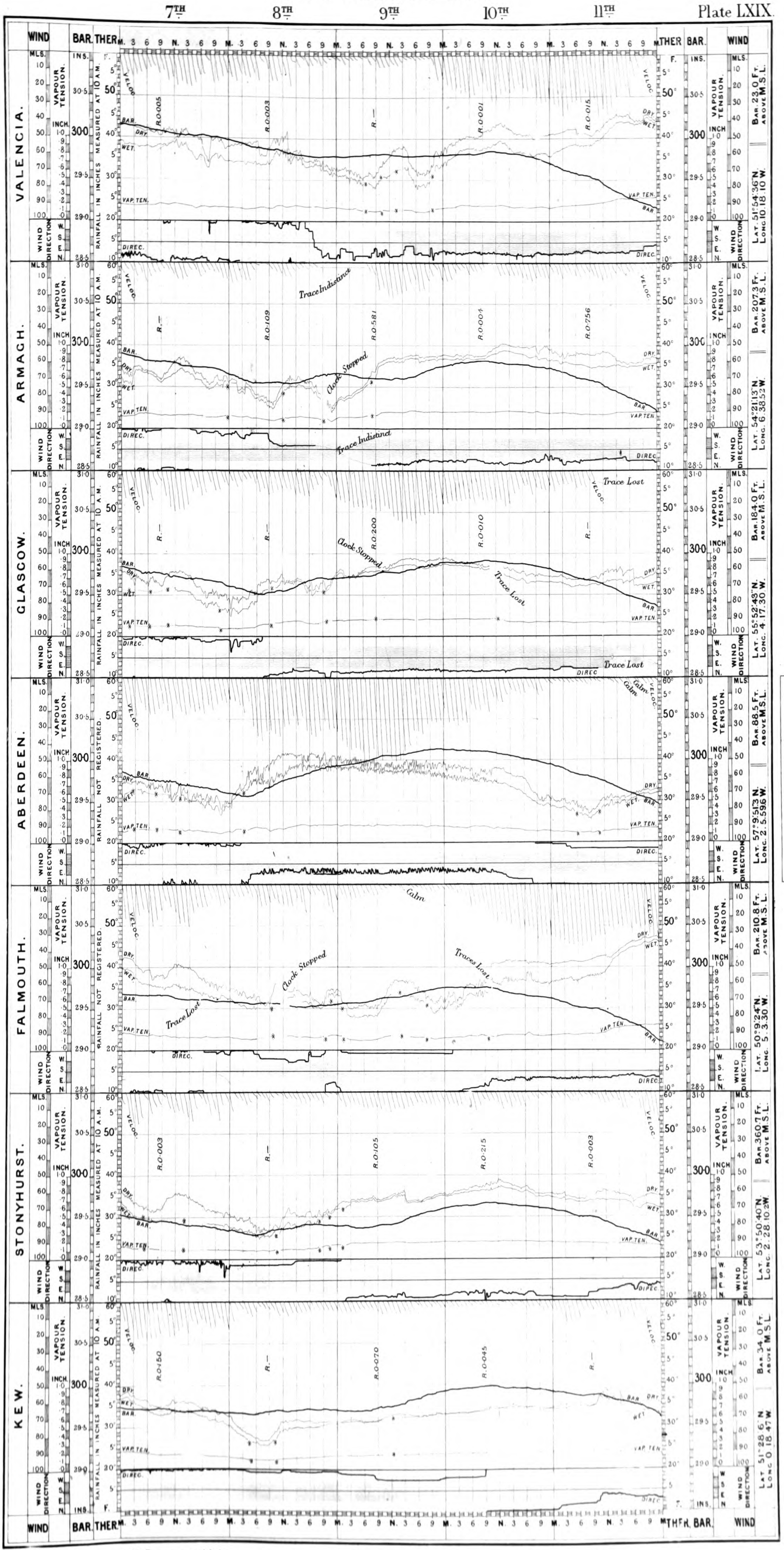
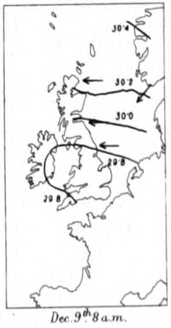


FIG. 56

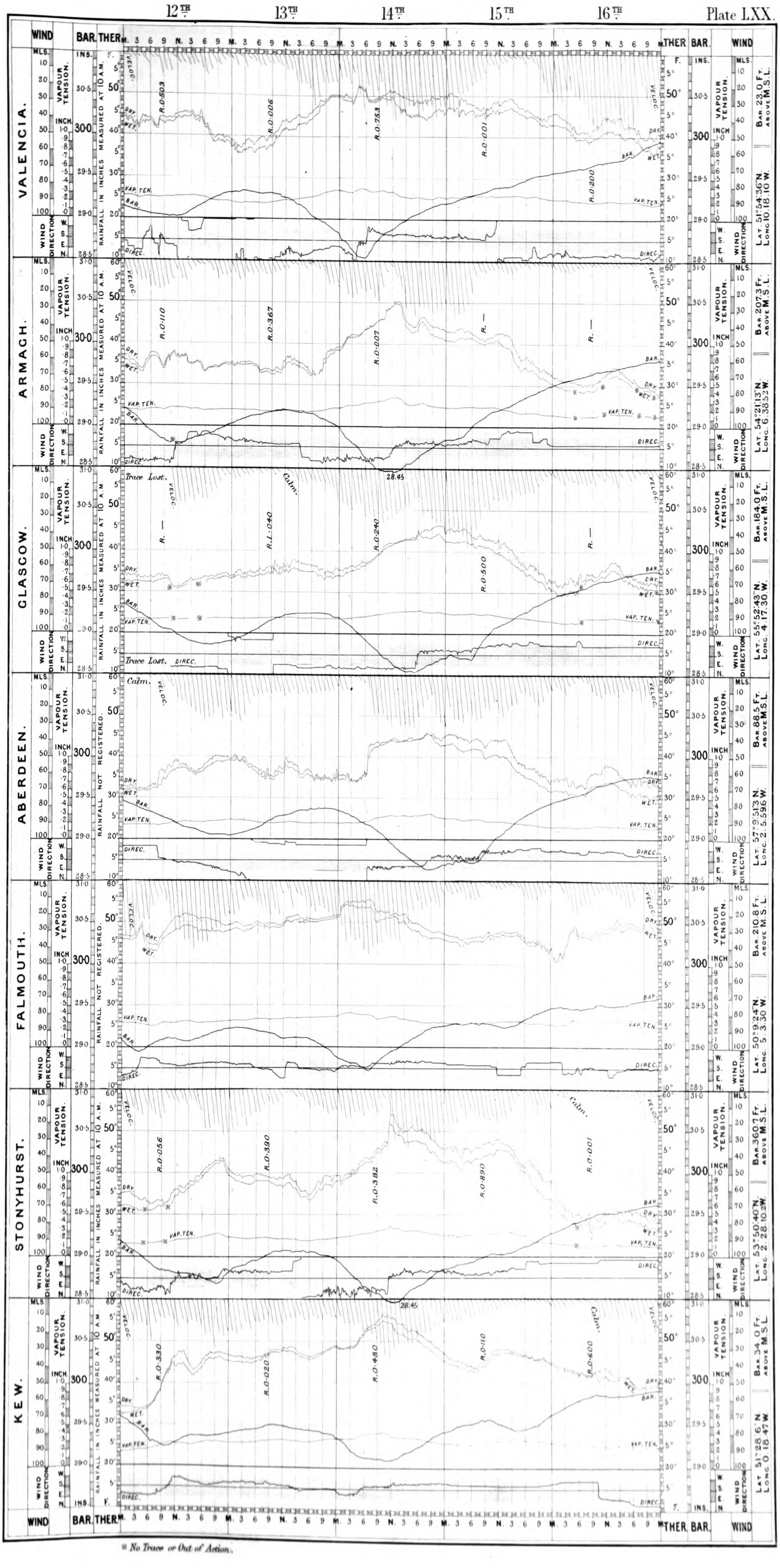

30.4
30.2
30.0
29.8
29.8

Dec. 9th 8 a.m.

* No Trace or out of Action.

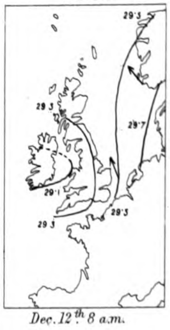
DECEMBER, — 1870.

Plate LXX.



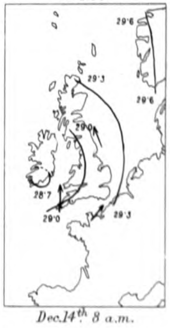
* No Trace or Out of Action.

FIG. 57.


29·3
29·1
29·7
29·3
29·3

Dec. 12th. 8 a.m.

FIG. 58.


29·6
29·3
29·6
29·0
28·7
29·0
29·3

Dec. 14th. 8 a.m.

DECEMBER._1870.

Plate LXXI

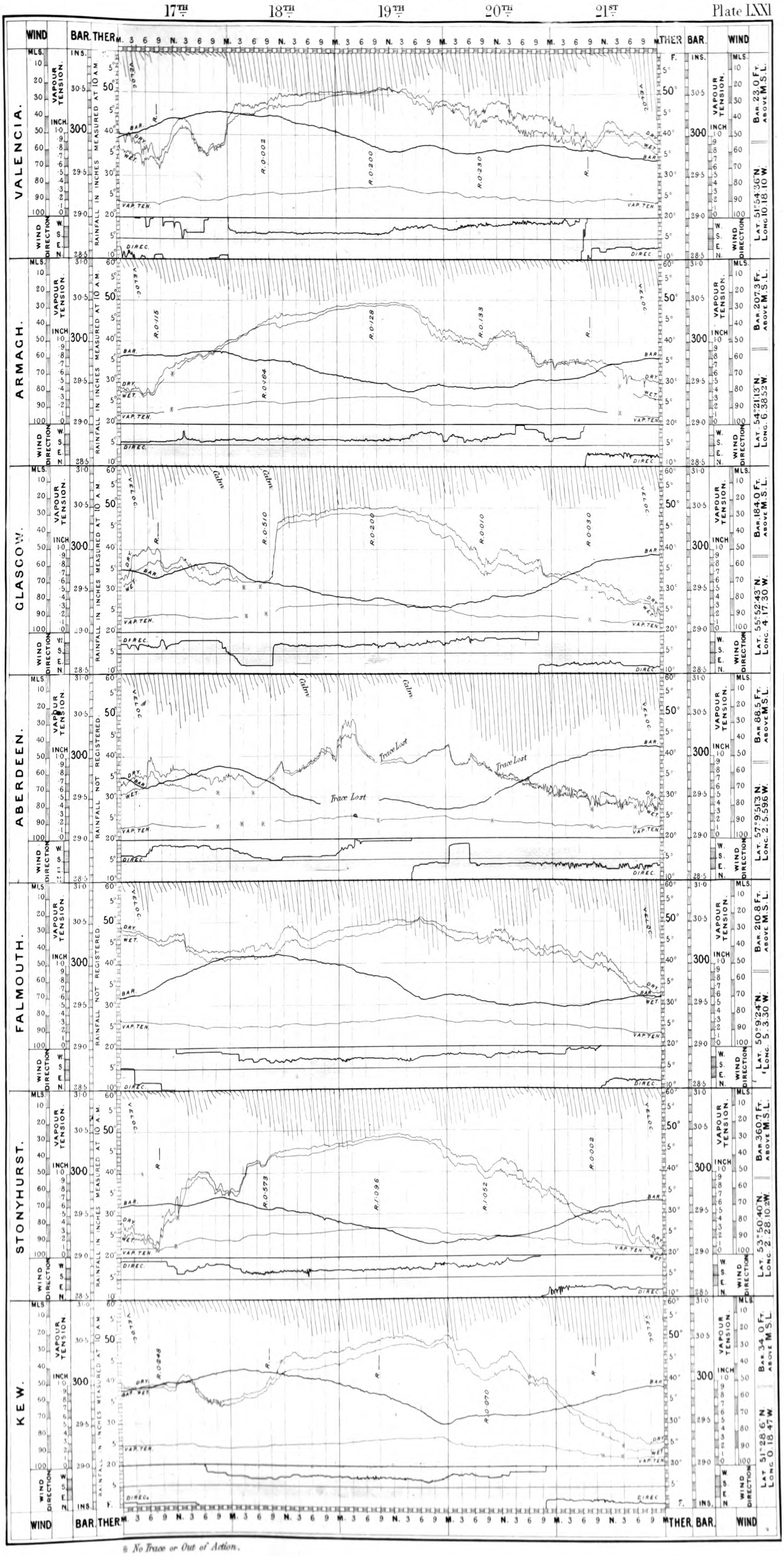
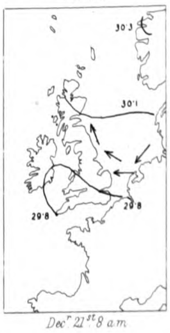


FIG. 59


30.3
30.1
29.8
29.8

Decr 21st 8 am

* No Trace or Out of Action.

DECEMBER, 1870.

Plate LXXII.

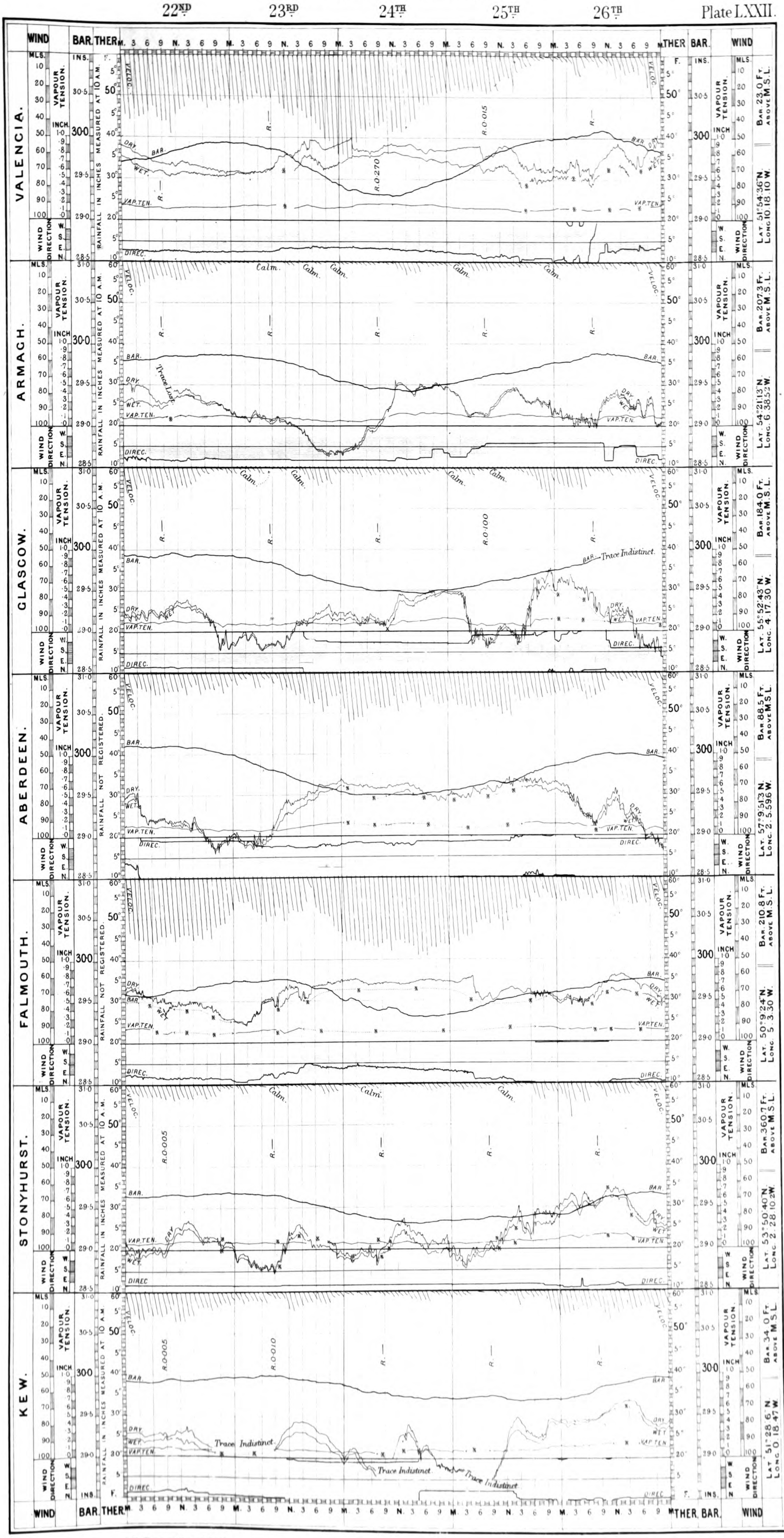
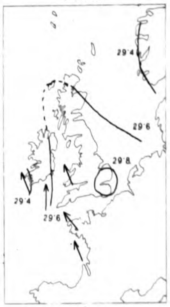


FIG. 60

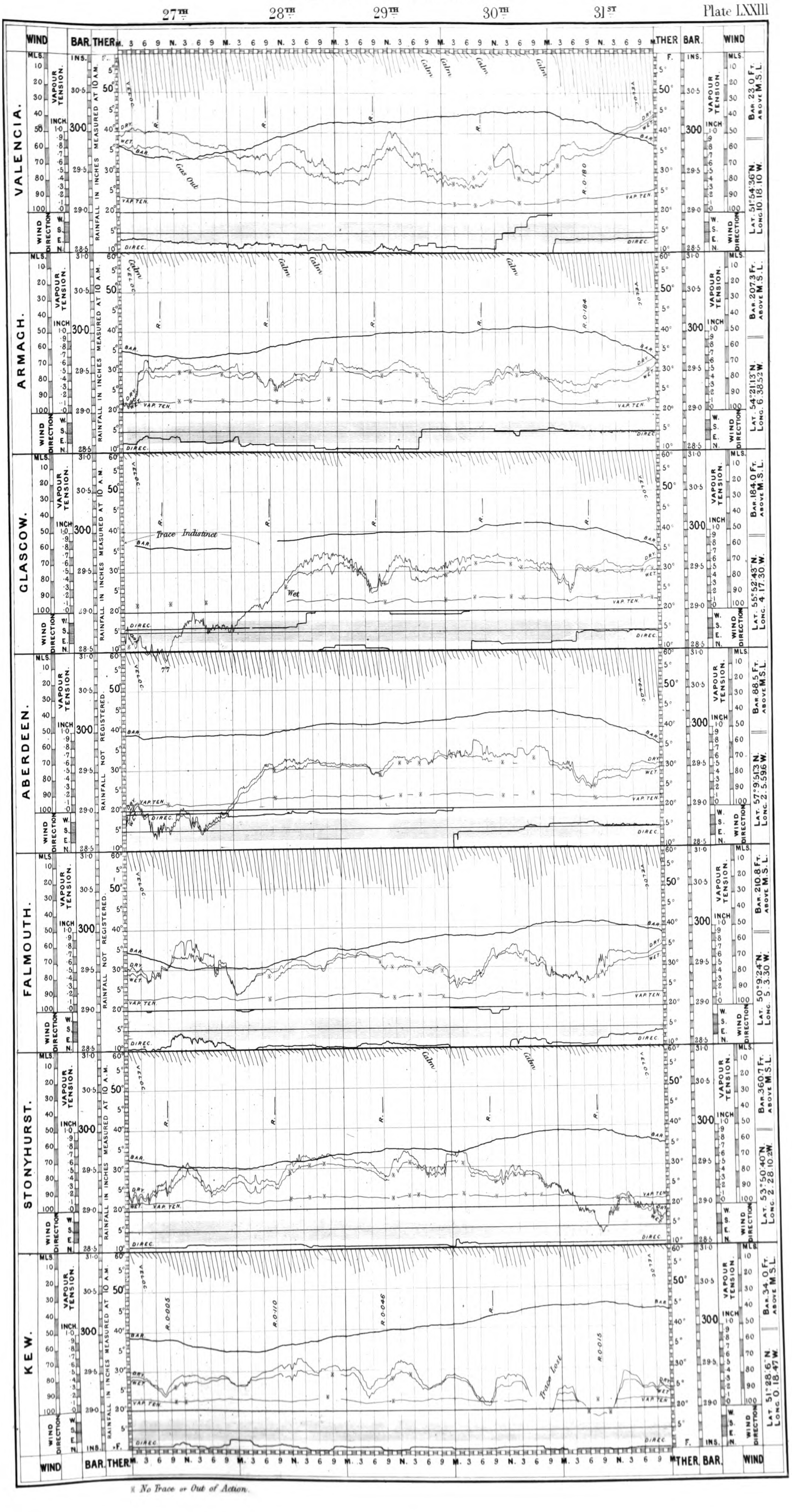

29·4
29·6
29·8
29·4
29·6

Dec. 24th 8 a.m.

x No Trace, or Out of Action.

DECEMBER, 1870.

Plate LXXIII



※ No Trace or Out of Action.